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Part I • The New JCAHO Hospital Standards: Their Effect on Respiratory Care

March 28, 12:30 p.m. to 2 p.m. Eastern Time—Nancy Telford, RRT with Moderator Sam P. Giordano, MBA, RRT

The new *1995 Accreditation Manual for Hospitals* is now organized around important functions that impact patient outcomes. With this redesign, the standards previously contained in the Respiratory Care Services Chapter are integrated into the functional chapters. Through this overview, viewers will learn about standards related to competence programs, responsibilities of department leaders and medical directors, and expectations on performance improvement. This presentation will also review the interactive survey process and the role of department staff.

Part II • Prevention and Management of Ventilator-Induced Lung Injury

April 25, 12:30 p.m. to 2 p.m. Eastern Time—David J. Pierson, MD with Moderator Richard D. Branson, RRT

There is increasing evidence that the way we manage mechanical ventilation affects the incidence and severity of parenchymal lung injury as well as traditional forms of barotrauma such as pneumothorax and bronchopleural fistula. This presentation will review the data from both animal experiments and clinical experience, and will describe our current concepts of the pathophysiology of ventilator-induced lung injury. It will also cover practical matters such as how to identify patients at increased risk of barotrauma, measures to decrease the likelihood of this complication, and the approach to management of bronchopleural fistula in the ventilated patient.

Part III • The Multidisciplinary Team Approach and Respiratory Care

June 20, 12:30 p.m. to 2 p.m. Eastern Time—Kevin L. Shrake, MA, RRT, CHE with Sam P. Giordano, MBA, RRT

This program will focus on what respiratory care practitioners must do to demonstrate value and create opportunity in the changing environment of health care. Strategies will be outlined on how to develop a professional skills inventory that enhances value and solidifies job security. Restructuring concepts will be presented that focus on developing the multiskilled practitioner capable of functioning on a variety of teams throughout the continuum of health care. Advice will also be provided for managers who want to position themselves as a member of a new breed of "clinical executives" who will guide the future of integrated health care delivery systems in the United States.

Part IV • Emergency Respiratory Care: The Respiratory Care Practitioner's Role

July 19, 12:30 p.m. to 2 p.m. Eastern Time—Charles G. Durbin, Jr., MD, FCCM with Richard D. Branson, RRT

As caregiver roles continue to blur, many new tasks will fall to the most prepared individual in the emergency care setting, regardless of profession. Emergency defibrillation, establishment of intravenous access, and IV and endotracheal drug administration are several areas in which RCPs can become competent. This session will review some of the new approaches to emergency care, "tricks of the trade" in airway maintenance, and changes in the ACLS philosophy and treatment protocols. Methods to increase RCP participation in the hospital emergency response team and the obstacles that they must overcome will be presented.

Part V • Noninvasive Mechanical Ventilation: Its Role in Acute and Chronic Ventilatory Failure

August 2, 12:30 p.m. to 2: p.m. Eastern Time—Nicholas S. Hill, MD with Richard D. Branson, RRT

Although techniques of noninvasive mechanical ventilation (assisting alveolar ventilation without an artificial endotracheal airway) have been with us for decades, recent developments have greatly increased their applicability. This presentation will briefly review the history of noninvasive ventilation, describe modalities of noninvasive ventilation currently available, and discuss the advantages and disadvantages of the various types. Results of studies on acute and chronic respiratory failure will be reviewed and acceptable indications for use of noninvasive ventilation will be described. Considerations for selecting appropriate patients and techniques of initiation and monitoring of noninvasive ventilation will also be discussed.

Part VI • Organizing a Respiratory Care Department without Walls

September 19, 12:30 p.m. to 2 p.m. Eastern Time—John R. Walton, MBA, MHA, RRT, CHE with Sam P. Giordano, MBA, RRT

With hospitals reengineering in advance of federal health reform, the successful respiratory care service must be poised to follow the flow of the patient from the acute hospital through alternate sites. Providing respiratory care in skilled nursing facilities, ambulatory clinics, and the home will require a new breed of respiratory care practitioner willing and able to advance beyond the acute care hospital walls. This "Professor's Rounds" will discuss how to establish respiratory services in the post-acute setting using examples of a successful respiratory care service established in a subacute, skilled nursing facility.

Part VII • Shortening Length of Stay on Ventilators and in Hospitals

November 14, 12:30 p.m. to 2 p.m. Eastern Time—Neil R. MacIntyre, MD with Richard D. Branson, RRT

This program will focus on the reasons patients remain ventilator dependent and the disease specific factors of ventilatory muscle overload, neurological dysfunction, and gas exchange difficulties as well as a discussion of maximizing therapy for the underlying cardiorespiratory disease as a component in shortening the patient's length of stay. The program will also discuss ventilation management issues and complications such as pneumothorax, imposed work from ventilator settings and equipment, aspiration pneumonia, nutrition, and fluid balance that can all contribute to unnecessary duration of mechanical ventilatory support.

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Surrogate End Points, Are They Meaningful? (editorial)—DM Fisher. Anesthesiology 1994;81(4):795-796.

Pathophysiology of Cor Pulmonale in Chronic Obstructive Pulmonary Disease. Part One (State of the Art)—W MacNee. Am J Respir Crit Care Med 1994;150:833-852.

Revealing the Link between Campaign Financing and Deaths Caused by Tobacco (editorial)—JA Califano Jr. JAMA 1994;272(15):1217-1218.

Further Recommendations for Prescribing, Reimbursement, Technology Development, and Research in Long-Term Oxygen Therapy (Consensus Conference Summary)—TL Petty and WJ O'Donahue Jr. Am J Respir Crit Care Med 1994;150:875-877.

Epidemiology of Failed Tobacco Control Legislation—S Moore, SM Wolfe, D Lindes,CE Douglas. JAMA 1994;272:1171.

OBJECTIVES: To evaluate the influence of tobacco industry campaign donations, district location, and political party affiliation on tobacco control legislation among members of the US Congress. DESIGN: Data were obtained from the Federal Election Commission money contributed by the 10 leading tobacco political action committees and by tobacco industry–aligned individuals to members of the U.S. House of Representatives (1991-1992) and Senate (1987-1992). Logistic regression analyses were performed using recorded votes and cosponsorship activities concerning tobacco control legislation during the 102nd and 103rd Congresses and membership on the House Congressional Task Force on Tobacco and Health as the dependent variables and tobacco money received, party, district location, and caucus or committee membership as the independent variables. SETTING: United States Congress in 1991 and 1992. INTERVENTIONS: None. MAIN OUTCOME MEASURE: Support for federal tobacco control legislation. RESULTS: The tobacco industry donated approximately $2.4 million to members of Congress from January 1991 through December 1992. House members received an average of $2,943 (1991-1992) and senators received an average of $11,593 (1987-1992). The more tobacco money a member received, the less likely the member was to support tobacco control legislation. In the Senate, on a vote to end the taxpayer subsidy of tobacco products in military stores, the odds ratio that senators in the top quartile of tobacco money recipients did not support the measure vs senators in the lowest quartile of tobacco money recipients was 42.2 (95% confidence interval, 4.1 to 430.0; $P < .001$). In the House, on a vote to end a $3.5 million subsidy to promote American tobacco abroad, the odds that House members in the top third of tobacco money recipients would oppose the legislation were 14.4 times greater (95% confidence interval, 5.5 to 39.0; $P < .001$) than for House members in the lowest third of tobacco money recipients. Receiving more tobacco money, being a member of the Republican party, and representing a tobacco producing state were all associated with decreased support for tobacco-control issues. The amount of tobacco money received was the variable most strongly and consistently associated with a lack of support for tobacco control legislation, even when we controlled for additional factors such as district location and party. CONCLUSION: Tobacco industry contributions to members of the U.S. Congress strongly influence the federal tobacco policy process. Unless this influence is diminished through a combination of members refusing tobacco money and campaign finance reform, this process of contributing to death by thwarting tobacco control will continue to claim hundreds of thousands of lives a year.

Tobacco Industry Campaign Contributions Are Affecting Tobacco Control Policymaking in California—SA Glantz, ME Begay. JAMA 1994; 272: 1176.

OBJECTIVE: To test the hypothesis that tobacco industry campaign contributions are influencing the behavior of members of the California legislature. DESIGN: Multivariate simultaneous-equations regression was used to analyze data on campaign contributions from the tobacco industry to members of the California legislature in 1991 and 1992, members' tobacco control policy positions, and members' personal characteristics. DATA SOURCES: The following sources were analyzed: campaign contributions from disclosure statements filed with the California Fair Political Practices Commission; constituent attitudes on tobacco control from the California

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Tobacco Survey; legislators' personal characteristics from a survey of key informants conducted by the *California Journal;* and the tobacco policy score, a survey of key informants working on tobacco issues in the state legislature. Specific voting on tobacco-related bills was also analyzed. SETTING: California legislature in 1991 and 1992. PATIENTS OR OTHER PARTICIPANTS: All members of the California legislature in 1991 and 1992. MAIN OUTCOME MEASURES: Tobacco policy score, campaign contributions, and votes on individual tobacco-related bills. RESULTS: The tobacco industry is having a statistically detectable effect on behavior of members of the California legislature on tobacco policymaking. On a scale of 0 to 10, a legislator's tobacco policy score dropped (ie, became more protobacco industry) by −0.11 for every $1000 in tobacco campaign contributions, after accounting for the fact that a more protobacco position was associated with greater contributions ($1855 for each −1.0 reduction in score). Members who were rated as effective received larger contributions from the industry. Members rated higher in integrity and intelligence were more antitobacco (higher scores) and Republicans more protobacco (lower scores) after taking into account the effects of contributions from the industry. Constituent attitudes were not reflected in legislators' perceived behavior. CONCLUSION: Tobacco industry campaign contributions influence California legislators in matters related to tobacco policymaking, independent of constituents' support for tobacco control.

Design and Development of Ultrathinwalled, Nonkinking Endotracheal Tubes of a New "No-pressure" Laryngeal Seal Design—T Kolobow, K Tsuno, N Rossi, and M Aprigliano. Anesthesiology 1994; 81:1061.

BACKGROUND: Endotracheal tubes (ETTs) of conventional design and manufacture greatly increase the air-flow resistance of the upper airways. This increase in upper-airway resistance can lead to significant increase in the work of breathing and may necessitate the use of assisted mechanical ventilation. Current ETTs are relatively stiff and contribute greatly to patient discomfort. The inflatable cuffs now mounted onto the ETTs function well in short-term use but impart significant morbidity when used over longer periods. These issues were addressed by the designing of a low-resistance ETT. METHODS: Using new techniques, we developed ultrathin-walled wire reinforced ETTs of conventional configuration and ETTs the oropharygeal-section diameter of which was a few millimeters larger than the diameter of the tracheal section. The wall thickness was a constant 0.20 mm. The wire reinforcement was stainless steel flat wire or superelastic nickel-titanium alloy. The superelastic nickel-titanium alloy reinforcement made those ETTs crush-proof; after forceful manual compression, recovery was complete. To obtain a seal with the upper airways, we first shaped a short section of the oropharyngeal section of the ETT from round to oval (or eggshaped) to conform better to the larynx. We then attached to this segment numerous soft pliable, 0.025-0.075-mm-thick rings of polyurethane to occlude voids for potential air leaks from within the larynx. RESULTS: In vitro pressure-flow studies showed a decrease by as much as four- or fivefold in air-flow resistance in the adult ETT range effectively increasing the internal diameter by 2.3-3.7 mm, compared with conventional ETTs of the same outside diameter. In vivo for 24 h in sheep showed no air leaks at airway pressures to 30 cm H_2O and minimal leak at greater pressures. The gross appearance of the trachea was normal. CONCLUSIONS: Although the new tubes appear to offer advantages to those currently used, testing in humans is required to assess the clinical utility of the tube-cuff design.

Safety and Potential Efficacy of an Aerosolized Surfactant in Human Sepsis-Induced Adult Respiratory Distress Syndrome—JG Weg, RA Balk, RS Tharratt, S G Jenkinson, JB Shah, D Zaccardelli, J Horton, EN Pattishall, for the Exosurf ARDS Sepsis Study Group. JAMA 1994; 272:1433.

OBJECTIVE: To evaluate the safety and potential efficacy of aerosolized surfactant in intubated patients with adult respiratory distress syndrome (ARDS). DESIGN: A prospective, double-blind, placebo-controlled, randomized, parallel, mutlicenter pilot clinical trial. PATIENTS: A total of 51 patients with sepsis-induced ARDS were entered into the study within 18 hours of developing sepsis or sepsis syndrome. INTERVENTION: Patients were randomized into four treatment groups in a 2:1:2:1 ratio, as follows: 12 hours of surfactant per day, 12 hours of 0.6% saline per day, 24 hours of surfactant per day, and 24 hours of 0.6% saline per day. Surfactant or saline was aerosolized continuously for up to 5 days using an in-line nebulizer that aerosolized only during inspiration. MAIN OUTCOME MEASURES: Ventilatory data, arterial blood gases, and hemodynamic parameters were measured at baseline, every 4 or 8 hours during the 5 days of treatment, 24 hours after treatment, and 30 days after treatment, at which time mortality was also assessed. Safety was evaluated throughout the 30 days of the study. RESULTS: Surfactant was administered safely in ventilated patients when given continuously throughout the 5 days using the nebulizer system. Although there were no differences in any physiological parameter between the treatment groups, there was a dose-dependent trend in reduction of mortality from 47% in the combined placebo group to 41% and 35% in the groups treated with 12 hours and 24 hours of surfactant per day, respectively. CONCLUSIONS: Aerosolized surfactant was well tolerated when administered on a continuous basis for up to 5 days; however, at the doses given, it did not result in significant improvements in patients with sepsis-induced ARDS.

Collateral Ventilation and Gas Exchange in Emphysema—NW Morrell, BK Wignall, T Biggs, and WA Seed. Am J Respir Crit Care Med 1994;150:635.

Resistance to collateral flow of gas is high in the normal human lung but may

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be lower in emphysema. However, the contribution of collateral ventilation to gas exchange in emphysema remains unclear. This study evaluates the role and magnitude of collateral ventilation between bronchopulmonary segments in six patients with clinical, functional, and computed tomographic evidence of emphysema, compared with our previous findings in 12 normal subjects. To assess collateral flow, a balloon-tipped catheter with a lumen that opened distal to the balloon was inflated in segmental bronchi during fiberoptic bronchoscopy. Respiratory gas tensions were sampled by mass spectrometer from beyond the occlusion via the catheter lumen. Subjects breathed air until occlusion was established and then switched to 79% helium/21% oxygen. The rate of rise of helium concentration was measured within occluded segments and used as an index of collateral ventilation. The mean (± SEM) rate of rise of helium concentration was ten times greater in emphysema patients (9.5 ± 2.7%/min) compared with normal subjects (0.8 ± 0.3%/min) ($p = 0.009$). The mean PO_2 within occluded segments was similar in normal subjects and emphysema patients: 45.4 ± 1.8 mm Hg and 44.8 ± 3.6 mm Hg, respectively. Mean PCO_2 within occluded segments was lower in patients (40.1 ± 1.9 mm Hg) than in normal subjects (46.4 ± 1.3 mm Hg), probably due to higher regional ventilation-perfusion ratios in emphysema patients rather than collateral ventilation. In emphysema patients there was a positive correlation between rate of rise of helium concentration and final PO_2 within an occluded segment ($r = 0.73$; $p = 0.02$). We conclude that collateral ventilation occurs to a much greater extent in the emphysematous than in the normal lung and may be responsible for the relative preservation of gas exchange characteristic of this condition.

Role of Cardiopulmonary Exercise Testing and the Criteria Used To Determine Disabilty in Patients with Severe Chronic Obstructive Pulmonary Disease—F Ortega, T Montemayor, A Sanchez, F Cabello, and J Castillo. Am J Respir Crit Care Med 1994;150:747.

The aim of this study was to evaluate the precision and variability with which resting pulmonary function tests (resting PFTs) can be used to predict the capacity in exercise, and the usefulness of the different measurements of pulmonary function in the evaluation of impairment/disability in patients with chronic obstructive pulmonary disease (COPD). We studied 78 patients with stabilized COPD (FEV_1, 45.1 ± 17.1%). Of these, 39 suffered severe impairment according to the resting PFTs. Both the group with severe impairment (maximal oxygen consumption [$\dot{V}_{O_2max}$]: 16.22 ± 5 ml/kg/min; maximal minute ventilation [$\dot{V}_{Emax}$]: 31.87 ± 7.1 L/min; maximal heart rate [HRmax]: 133.8 ± 10.9 beats/min) and the group with non-severe impairment according to the resting PFTs ($\dot{V}_{O_2max}$: 22.55 ± 7.9 ml/kg/min; $\dot{V}_{Emax}$: 42.11 ± 10.9 L/min; HRmax: 138 ± 13.7 beats/min) showed ventilatory limitation during exercise. FEV_1 was the most prevalent criterion for the determination of severe impairment (FEV_1, < 40%), and was the variable best correlated to $\dot{V}_{O_2max}$ ($r = 0.52$ with $\dot{V}_{O_2max}$ as absolute value and $r = 0.54$ with $\dot{V}_{O_2max}$ expressed as a percentage of the reference value), but the resting PFTs were not predictive of exercise performance including patients with severe COPD. Evaluation of working capacity (based on $\dot{V}_{O_2max}$) revealed a significant number of inaccurate predictions among the results of the resting PFTs. Sensitivity and specificity analysis were used to compare the different criteria used to evaluate the severity of disability. They reveal that the classification will be different according to the criteria used. The criteria that classified more patients similarly were $\dot{V}_{O_2max} < 60\%$ of the reference values (sensitivity of 64.1% and specificity of 66.6%) and $\dot{V}_{O_2max} < 15$ mL/kg/min (sensitivity of 41% and specificity of 79.5%). The impairment rating whenever the theoretical energy requirements of the job exceeded 40% of the patients' $\dot{V}_{O_2max}$ (handicap) was contradicted by other exercise criteria. A combination of exercise testing results and job energy requirement may be necessary for an accurate determination of impairment/disability for the individual subject.

Risk Factors and Clinical Relevance of Nosocomial Maxillary Sinusitis in the Critically Ill—J-J Rouby, P Laurent, M Gosnach, E Cambau, G Lamas, A Zouaoui, J-L Leguillou, L Bodin, TD Khac, C Marsault, P Poète, M-H Nicolas, V Jarlier, and P Viars. Am J Respir Crit Care Med 1994;150:776.

The incidence of infectious maxillary sinusitis (IMS) and its clinical relevance was prospectively studied in 162 consecutive critically ill patients who were mechanically ventilated for a period longer than 7 d. All had a paranasal computed tomographic (CT) scan within 48 h of admission and were divided into three groups according to the radiologic aspect of their maxillary sinuses: Group 1 = normal maxillary sinuses (n = 40) Group 2 = maxillary mucosal thickening (n = 26) Group 3 = radiologic maxillary sinusitis (RMS) defined as the presence of an air fluid level and/or opacification of maxillary sinuses (n = 96). Group 1 patients were randomized between nasal and oral endotracheal intubation with a gastric intubation performed via the same route and had a second paranasal CT scan 7 d later. Endotracheal and gastric tubes were left in their original position in Group 2 patients and a second paranasal CT scan was performed 7 d later. All patients of Group 3 underwent a transnasal puncture for bacteriologic analysis of maxillary sinus content. Forty-five spontaneously breathing patients served as a control group. In all patients with RMS the occurrence of bronchopneumonia (BPN) was prospectively assessed for 7 d following the initial CT scan. Upon inclusion only 25% of the patients had normal maxillary sinuses whereas all patients in the control group had normal paranasal CT scans. After 7 d, 46% of Group 2 patients had evidence of RMS. Risk factors for RMS were nasal placement and duration of endotracheal and gastric intubation. In Group 1 patients, placement of endotracheal and gastric tubes to the oral route decreased the incidence of RMS from 95.5% to 22.5% ($p < 0.001$). After transnasal puncture only 38% of RMS were considered IMS. Qualitatively 47% of the microorganisms isolated were

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gram-negative bacteria. Quantitatively, 60% of the isolated microorganisms were found in concentrations $>10^3$ cfu/ml. BPN were more frequent in patients with IMS than in those with noninfectious maxillary sinusitis (67% versus 43%, $p < 0.02$). Following maxillary drainage, signs of sepsis resolved in 47% of patients with IMS. In conclusion, IMS is an important focus of infection frequently associated with BPN in ventilated critically ill patients. Its incidence can be markedly reduced by inserting endotracheal and gastric tubes via the oral route.

Nocturnal Nasal Continuous Positive Airway Pressure in Patients with Chronic Obstructive Pulmonary Disease—WS Mezzanotte, J Tangel, AM Fox, RD Ballard, DP White. Chest 1994; 106:1100.

Patients with COPD often have reduced inspiratory muscle strength and endurance as well as poor exercise tolerance. Increased inspiratory work during sleep (probably due to increased upper airway resistance) may further strain these compromised respiratory muscles in COPD patients. We hypothesized that nasal continuous positive airway pressure (CPAP) might reduce respiratory work during sleep in COPD patients and thereby improve waking inspiratory muscle function. To test this hyothesis, eight male COPD patients were treated with sustained nocturnal nasal CPAP. Inspiratory muscle strength (maximum inspiratory pressure) and endurance (sustained inspiratory pressure) as well as clinical performance (12-min walk) were assessed before and after therapy. We observed that compared with matched controls, COPD patients treated with nocturnal nasal CPAP had significant and substantial improvement in inspiratory muscle strength and endurance as well as functional ability as assessed by the 12-min walk. In addition, CPAP did not significantly alter sleep quality or oxygenation in the patients studied. We conclude that nocturnal nasal CPAP improves inspiratory muscle performance during wakefulness in COPD patients, which is very likely a product of the reduced work of breathing during sleep while these individuals received CPAP.

Improved Outcome for Young Children with AIDS, *Pneumocystis carinii* Pneumonia, and Acute Respiratory Failure—HR Wong, KR Chundu. Pediatr Pulmonol 1994;18:114.

OBJECTIVE: To describe the clinical course of children with acquired immunodeficiency syndrome, requiring mechanical ventilation secondary to *Pneumocystis carinii* pneumonia, with respect to intensive care unit outcome, long-term survival after intensive care unit discharge, and possible predictors of outcome. DESIGN: Retrospective case series. SETTING: Multidisciplinary, tertiary, pediatric intensive care unit. PATIENTS: Thirteen consecutive patients accounting for 15 admissions to the intensive care unit, from September 1986 through December 1991, with the diagnoses of acquired immunodeficiency syndrome, *P. carinii* pneumonia, and acute respiratory failure requiring mechanical ventilation. RESULTS: All patients were less than 2 years of age and acquired human immunodeficiency virus infection perinatally. Survival after 15 admissions to the intensive care unit was 60%. Mean (±SD) and median longterm survival for the nine intensive care unit survivors was 30.6 ± 12.9 months and 27 months, respectively. Maximum oxygenation index and minimum partial pressure of arterial oxygen to fraction of inspired oxygen ratio were significantly different between survivors and nonsurvivors. CONCLUSIONS: Young children with acquired immunodeficiency syndrome who develop acute respiratory failure secondary to *P. carinii* pneumonia and who require mechanical ventilation may have a better acute outcome and long-term survival than previously reported.

Persistent Wheezing and Gastroesophageal Reflux in Infants—NS Eid, RW Shepherd, MA Thompson. Pediatr Pulmonol. 1994;18:39.

We have evaluated the presence of gastroesophageal reflux (GER) and the effect of its treatment in 12 infants (mean age, 7 months; range, 4-11 months) with persistent wheezing not responding to bronchodilators and anti-inflammatory asthma medications. All patients had GER on cineradiography and significant acid reflux on 24 hour pH monitoring (percentage of time pH <4 ranged from 6.1 to 47%). All infants were initially treated with prokinetic agents and with receptor histamine antagonists in addition to aggressive pulmonary therapy. Six patients treated medically had substantially decreased use of asthma medications, completely discontinuing them within 2-4 months. Two patients, though significantly improved, require intermittent asthma therapy. Four patients responding poorly to GER and asthma treatment for 2 months to 2 years had fundoplications. These had an excellent outcome over 1-4.5 years follow-up; only one patient required further asthma medications. Pulmonary function testing was done in six patients before and after 6-8 weeks of therapy indicating significant improvement in peripheral airflow: terminal flow/peak tidal expiratory flow (TEF_{25}/PTEF), and percentage of total expiratory time to reach peak tidal expiratory flow (T_p/T_e or T_{me}/T_e) Our experience suggests that evaluation for GER should be considered in infants with persistent wheezing. Aggressive medical and possibly surgical therapy for GER may resolve persistent wheezing.

Reversal of Bronchial Obstruction in Children with Mild Stable Asthma by Aerosolized Furosemide—T Chin, L Franchi, E Nussbaum. Pediatr Pulmonol, 1994;18:93.

Aerosolized furosemide has been shown to prevent the worsening of different variables in pulmonary function testing, following exercise or bronchial provocation with numerous agents. To investigate if aerosolized furosemide has a bronchodilator effect, we performed two prospective, randomized, placebo-controlled, double-blinded and crossover studies of four aerosol regimens in children with mild chronic asthma. In a pilot study examining three different doses of

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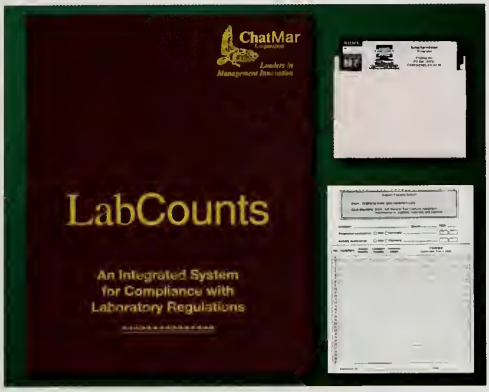

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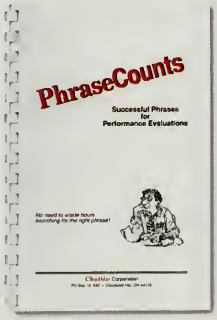

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furosemide in 11 children, the dose of 1.0 mg/kg resulted in a mean maximum increase of 30.0 ± 6.8% in forced expiratory flow between 25 and 75% vital capacity (FEF_{25-75}), compared with a 3.1 ± 6.8% increase after aerosolized normal saline. The effect was observed after 10 minutes with a mean percent change of 17.7 ± 1.7% from baseline, that persisted to 30 minutes (19.3 ± 3.7%) and was significantly greater than that seen following aerosolized placebo (1.4 ± 2.9% and 0.7 ± 3.4%, respectively; $P < 0.05$). We then compared the effect of furosemide with that of aerosolized albuterol (0.15 mg/kg) in 18 patients. There was no statistically significant difference in the improvement observed in forced expiratory volume in 1 second (FEV_1) for albuterol (15.0 ± 2.7%) compared with furosemide (12.1 ± 2.9%) or in FEF_{25-75} (42.9 ± 9.0% versus 26.3 ± 6.7%). The addition of albuterol to furosemide resulted in a 17.2 ± 5.9% increase in FEV1 and a 51.1 ± 13.9% increase in FEF_{25-75}. Our results indicate that aerosolized furosemide has a bronchodilator effect in children with mild stable asthma.

Role of Positive End Expiratory Pressure Changes on Functional Residual Capacity in Surfactant Treated Preterm Infants—W Jose da Silva, S Abbasi, G Pereira, VK Bhutani. Pediatr Pulmonol 1994;18:89.

SUMMARY: Both surfactant replacement and positive end-expiratory pressure (PEEP) increase lung volume in infants with respiratory distress syndrome (RDS). We measured pulmonary mechanics and functional residual capacity (FRC) in 21 preterm infants with RDS, > 48 hr post-surfactant therapy (BW, 1,168 ± 441 g; GA, 28.3 ± 2.8 weeks; postnatal age, 3-7 days). A nonlinear but significant increase in mean FRC was noted as PEEP increased from 2 to 5 cm H_2O:18.4 ± 4.7 mL/kg at 2 cm H_2O; 19.7 ± 4.3 mL at 3 cm H_2O; 22.6 ± 5.5 mL/kg at 4 cm H_2O; and 26.2 ± 6.2 mL/kg at 5 cm H_2O ($P < 0.01$). Because of the synergistic combined effect on lung volume, surfactant treated neonates should be weaned cautiously from PEEP during ventilatory management. Our study also suggests that the occurrence of inadvertent end-expiratory distending pressure during FRC measurement in the ventilated neonate leads to erroneous results.

Measurement of Lung Volume and D_{LCO} in Acute Respiratory Failure—PD Macnaughton and TW Evans. Am J Respir Crit Care Med 1994;150:770.

We have undertaken rebreathing measurements of functional residual capacity (FRC), carbon monoxide diffusing capacity (D_{LCO}), and diffusing coefficient (K_{CO}) during positive pressure ventilation in 15 patients with adult respiratory distress syndrome (ARDS). Measurements of oxygenation (P_{aO_2}:F_{IO_2} ratio and lung injury score (LIS) were also recorded. Eight patients subsequently died (mortality of 53%). There was no significant difference in mean FRC, P_{aO_2}:F_{IO_2}, or LIS at presentation between survivors and nonsurvivors. However, both D_{LCO} and K_{CO} at presentation were significantly greater in survivors than nonsurvivors. In a separate study of nine patients with less severe lung injury, pulmonary capillary blood volume, derived from values of D_{LCO} measured at two different values of F_{IO_2}, correlated with invasive pulmonary vascular resistance (PVR) measurements ($r = 0.84$, $p < 0.01$). D_{LCO} measurements can be successfully undertaken in patients being ventilated with acute lung injury and may be a useful, noninvasive method of assessing the pulmonary circulation. The lowest values of D_{LCO} were recorded in patients who subsequently did not survive.

Use of Flow-Volume Curves in Detecting Secretions in Ventilator-Dependent Patients—A Jubran and MJ Tobin. Am J Respir Crit Care Med 1994;150:766.

A noninvasive means of detecting airway secretions in ventilator-dependent patients is desirable because endotracheal suctioning can result in life-threatening complications. In a patient who had copious secretions, we observed a sawtooth pattern on his flow-volume curve that disappeared after suctioning. Accordingly, we systematically examined the usefulness of a sawtooth pattern on flow-volume curves in detecting secretions in ventilator-dependent patients and compared its accuracy with clinical examination. Flow-volume curves were recorded in 50 ventilator-dependent patients over 1 min of spontaneous breathing. In 15 of these patients, clinical examination was performed by three clinicians to determine its accuracy in detection of secretions. Endotracheal suctioning was then performed to determine the presence or absence of secretions. Subsequently, the flow-volume curves of all 50 patients were played back on a video screen, and three observers, who were unaware of the results of suctioning, made a decision regarding the presence or absence of a sawtooth pattern. The sensitivity of the sawtooth pattern in detecting secretions ranged from 0.76 to 0.86, and specificity ranged from 0.86 to 0.90. The likelihood ratio of a positive test ranged from 5.55 to 7.97, whereas the likelihood ratio of a negative test ranged from 0.16 to 0.27. Interobserver agreement, assessed by the kappa statistic, was excellent: 0.76, 0.76, and 0.84. In the subgroup of patients evaluated by both clinical examination and flow-volume curve analysis, clinical examination was less accurate in 11 of the 15 patients. In conclusion, detection of a sawtooth pattern strongly suggests the presence of secretions, and the absence of this pattern suggests that secretions are unlikely to be present.

Effects of Breathing a Normoxic Helium Mixture on Exercise Tolerance of Patients With Cystic Fibrosis—D Martin, J Day, G Ward, E Carter, Chesrown S. Pediatr Pulmonol. 1994; 18:206.

Breathing helium-oxygen (He-O_2) mixtures of 20.9% O_2/79.1% He has been shown to increase exercise ventilation and peak oxygen uptake in healthy subjects. The improved exercise performance is thought to be due to the reduced density of He-O_2 compared to air and the resulting increases in ventilation. Patients with cystic fibrosis (CF) frequently have ab-

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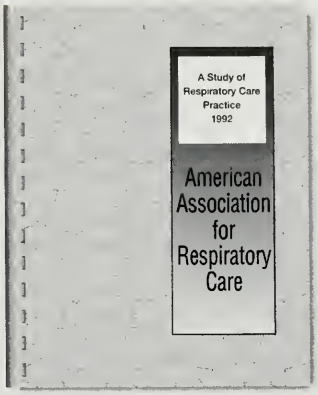

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normal pulmonary function test results, low exercise ventilations and diminished exercise tolerance. This led to the hypothesis that in CF the exercise tolerance of patients might improve when breathing He-O_2. To test this hypothesis, 11 patients with CF or mild to severe airway obstruction performed spirometry and progressive maximal exercise tests while breathing air or He-O_2. The He-O_2 mixture significantly increased ($P < 0.05$) forced expiratory volume in 1 sec (FEV_1) by 8.2%, peak expired flow by 39%, and maximal voluntary ventilation (MVV) by 17.9% compared to air, while forced vital capacity (FVC) and forced mid-expiratory flow rate ($FEF_{25\ 75\%}$) were unchanged by breathing He-O_2. Ventilation and oxygen uptake at matched submaximal power outputs were not increased while breathing He-O_2, nor were peak exercise ventilation ($\dot{V}_{Epeak}$) or peak exercise oxygen uptake ($\dot{V}_{O_2peak}$). Estimated hemoglobin saturation and total exercise time were also unchanged during He-O_2 breathing. However, there was a trend for the subjects with the better FEV_1 to increase $\dot{V}_{O_2peak}$. Increases in $\dot{V}_{O_2peak}$ when breathing He-O_2 and air were correlated ($r = 0.67$, $P < 0.05$) with the percent of predicted FEV_1 values. Still, in the 11 patients as a group, breathing He-O_2 did not significantly improve $\dot{V}_{O_2peak}$, $\dot{V}_{Epeak}$, or exercise tolerance. Therefore He-O_2 is unlikely to have additional benefits to patients with CF who use an exercise program to help optimize their health status.

Imposed Work and Oxygen Delivery during Spontaneous Breathing with Adult Disposable Manual Ventilators—D Hess, C Hirsch, C Marquis-D'Amico, and RM Kacmarek. Anesthesiology 1994;81(5):1256.

BACKGROUND: Manual ventilators (resuscitators) are used primarily to ventilate the lungs of patients lacking spontaneous ventilatory effort. However, in many settings patients are allowed to breathe through the manual ventilator. Although many aspects of manual ventilator function have been studied, very little has been reported on the use of manual ventilators during spontaneous breathing. The purpose of this study was to evaluate inspiratory and expiratory imposed work of breathing and oxygen delivery during spontaneous breathing through disposable manual ventilators. METHODS: Simulated spontaneous breathing was established with a two-chambered test lung, with one chamber serving as the test chamber and the other as the driving chamber. Imposed work of breathing was evaluated with decelerating inspiratory flow at a rate of 20 breaths/min at tidal volume (V_T) 0.25 and peak flow 40 L/min, at V_T 0.5 and peak flow 80 L/min, and V_T 0.8 and peak flow 120 L/min. Flow (integrated to volume) and pressure were measured between the manual ventilator and test lung, and inspiratory and expiratory imposed work of breathing were calculated by integration of the volume-pressure curve. Oxygen concentration was measured with an oxygen analyzer placed between the manual ventilator and the test lung at 20 breaths/min, V_T 0.5, and flow 45 L/min. An oxygen flow of 15 L/min was added to the device for all evaluations. Two of the manual ventilators had built-in positive end-expiratory pressure valves, and imposed work was evaluated at 10 cm H_2O with these. RESULTS: There were significant differences in imposed work between inspiration and expiration ($P < 0.001$) and among the three levels of ventilatory demand ($P < 0.001$). For each ventilatory demand, there was a significant difference in work between manual ventilator brands for inspiratory work and expiratory work ($P < 0.001$). At a V_T of 0.5 and peak flow of 80 L/min, the pooled inspiratory imposed work for all manual ventilators was 0.44 ± 0.12 J/L, and the pooled expiratory imposed work was 0.29 ± 0.05 J/L. With 10 cm H_2O positive end-expiratory pressure, the inspiratory imposed work was very high (> 1 J/L). Four of the devices were unable to deliver more than 0.85 oxygen concentration at the spontaneous ventilatory pattern evaluated. CONCLUSIONS: Adult disposable manual ventilators produce a substantial imposed work of spontaneous breathing, which is increased with the addition of positive end-expiratory pressure. With some manual ventilators, a high oxygen concentration may not be delivered during spontaneous breathing. We recommend that patients not be allowed to spontaneously breathe through disposable manual ventilators.

Randomised Controlled Trial of Respiratory Rehabilitation—RS Goldstein, EH Gort, D Stubbing, MA Avendano, and GH Guyatt. Lancet 1994;344:1394.

Disability associated with chronic obstructive pulmonary disease has led to the development of rehabilitation programmes that aim to increase exercise tolerance and improve quality of life. Many reports of the benefits of rehabilitation have been from uncontrolled trials and unsupervised programmes. In view of the commitment asked of patients, their families, and health-care professionals, rehabilitation should be justified by a demonstration of sustained improvement over conventional treatment. We undertook a prospective randomised controlled trial of respiratory rehabilitation in 89 subjects (44 men, 45 women) aged 66 (SD 7) years with severe but stable chronic obstructive pulmonary disease who received rehabilitation or conventional community care. The treatment group were rehabilitated as inpatients for 8 weeks and supervised as outpatients for 16 weeks. Primary outcome measures of exercise tolerance and quality of life were made at baseline and repeated at 12, 18, and. 24 weeks. The difference between baseline and last follow-up was significant for 6 min walk distance (37.9 m [95% CI 10.8-65.0], $p = 0.0067$) and submaximal cycle time (4.7 min [2.1-7-3.]). There were also significant differences in questionnaire assessment of dyspnoea ($p = 0.0061$), emotional function ($p = 0.0150$), mastery ($p = 0.0002$), and dyspnoea index ($p = 0.0053$). Improvements in exercise tolerance and quality of life can be achieved and sustained for 6 months in patients undergoing respiratory rehabilitation compared with those receiving conventional care.

Pulmonary Response to an Inhaled Bronchodilator in Chronically Ventilated Preterm Infants with Suspected Airway Reactivity

William J Holt RPFT RRT, Jay S Greenspan MD, Michael J Antunes MD, James A Cullen RN BSN, Alan R Spitzer MD, and Thomas E Wiswell MD

BACKGROUND: Airway reactivity is a common clinical problem in infants who require prolonged ventilator support. The decision to utilize inhaled bronchodilator therapy is frequently based on the patient's history and on the presence of intermittent wheezing and bronchospasm during examination. The response to this therapy is often difficult to quantify. METHODS: We retrospectively analyzed dynamic compliance (C_{dyn}) and total respiratory-system resistance (R_I [inspiratory], R_E [expiratory], R_{tot} [total]) by esophageal manometry and pneumotachography before (PRE) and 20 minutes after (POST) 1 actuation (90 μg) of albuterol sulfate via the endotracheal tube in 25 intubated infants (mean [SD] weight at study 1.65 [1.05] kg, mean [SD] age at study 6.6 [4.6] weeks, and mean [SD] gestational age 28 [4] weeks). These infants had been receiving mechanical ventilation and were suspected of having increased airway reactivity. Functional residual capacity (FRC) had been determined by helium dilution prior to study. RESULTS: There were no significant differences between PRE and POST values of tidal volume, minute ventilation, or peak airway pressure, C_{dyn}, R_{tot}, or R_I R_E was significantly reduced POST ($p < 0.05$). Ten infants had a greater than 25% decrease in R_{tot} after albuterol, whereas 9 babies had less than a 25% decrease in R_{tot}. An additional 6 neonates had a greater than 25% increase in R_{tot} when compared to their PRE value. Tidal flow-volume-loops revealed evidence of tracheobronchomalacia (TBM) in 4 of 9 nonresponders in PRE treatment testing, and in 2 of 6 negative responders in POST-treatment testing. R was lower PRE in the negative-response group compared to the positive-response and no-response groups. CONCLUSION: Measurement of lung function may be helpful in assessing response to bronchodilator therapy in preterm infants, and unnecessary use of this therapy can be avoided in patients who do not have a positive response. Such studies may also predict which infants will not respond to inhaled bronchodilator therapy. Increased airway reactivity may be clinically indistinguishable from fixed airway obstruction or TBM. [Respir Care 1995;40(2):145-151.]

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Introduction

Airway abnormalities in preterm infants requiring long-term ventilatory support are commonly encountered in the intensive care nursery. Fixed airway obstruction such as tracheal stenosis may be undetected until extubation, depending on the severity and length of the stenotic lesion.[1] Other obstructive abnormalities such as reactive airway disease and TBM may present clinically as failure to wean with or without audible expiratory wheezing, retained secretions, and a radiographic picture of migratory atelectasis.[2] Inhaled bronchodilators may be used as part of the treatment regimen for these conditions.[3,4] Some authors be-

lieve such therapy is ineffective because of the relative lack of bronchial smooth muscle development in the preterm infants.[1,5] However, a growing body of evidence suggests that airway reactivity plays a substantial role in the pulmonary morbidity associated with prematurity.[6-8] In addition, some investigators have examined several modes of delivery of bronchodilators in ventilator circuits, as well as various aerosol-producing mechanisms such as jet nebulizers, ultrasonic nebulizers and metered dose inhalers.[9-13] Nevertheless, controversy as to the effectiveness of bronchodilators in these patients remains.

Pulmonary function analysis can quantitate and qualitate lung dysfunction. Alterations in lung compliance generally correlate with changes in the lung parenchyma, whereas changes in resistance most often reflect changes in airway function.[14] A profound change in a measured variable may be due to a specific etiology and revert to normal with some form of inhalation therapy.[14] Therefore the assessment of pulmonary mechanics in infants may have significant diagnostic and therapeutic value, ie, the reversibility or improvement of certain pulmonary-function abnormalities can be evaluated on an individual basis, regardless of the infant's gestational age. The purposes of this investigation were to find whether bronchodilator therapy is effective in premature infants with clinical evidence of airway reactivity and to determine the value of pulmonary-function testing on neonatal patients who are chronically ventilated.

Materials and Methods

Patient Population

We retrospectively reviewed data taken from 25 infants, mean (SD) gestational age of 28 (4.4) weeks. These babies were chronically dependent on mechanical ventilation. At the time of study, the infants' mean (SD) age was 6.6 (4.6) weeks, and their mean (SD) weight was 1.65 (1.05) kg. The decision to use inhaled bronchodilator therapy was based on the suspicion of airway reactivity from physical examination (ie, presence of wheezing and history of failure to wean), the requirement of increasing respiratory support, or migratory atelectasis (shifting areas of atelectasis on two or more consecutive chest films taken on the same day). All assessments were made by the attending neonatologist in the intensive-care nursery.

Pulmonary-Function Testing

Using an integrated infant pulmonary function testing system,* data were obtained while the infants were in a supine head-neutral position and resting quietly. Sedation was not used. Transpulmonary pressure and airflow were measured simultaneously. The babies were ventilated with a standard pressure-limited, time-cycled, infant ventilator. Pulmonary function testing was performed at a minimum ventilator rate of 40 breaths per minute in an effort to override spontaneous breathing activity. A positive end-expiratory pressure of 4 cm H_2O was used, while the peak inspiratory pressure was maintained at individually prescribed settings. Inspiratory time was usually set at 0.5 seconds and was not altered during the testing period. Intrapleural pressure was estimated by esophageal pressure measured via an orally placed water-filled esophageal catheter (8-Fr), connected with a three-way stopcock to a differential pressure transducer. The catheter was advanced into the stomach, and placement was confirmed by temporarily disconnecting the ventilator and observing positive deflections on the graphic display during inspiratory efforts. The catheter was then retracted until the deflections became negative on inspiration and was withdrawn an additional 0.5 to 1.5 cm depending on the infant's size. The catheter was marked and secured to the endotracheal tube with tape.

Proximal-airway pressure was measured by a differential pressure transducer through a side port in a pneumotachograph. The difference between intrapleural and proximal-airway pressures was our estimate of transpulmonary pressure. Volume measurements were computed by digital integration of the airflow signal from the pneumotachograph. Sampling of pressure and flow signals occurred during 60 seconds of quiet sleep. Dynamic lung compliance (C_{dyn}) and total respiratory-system resistance (R_I [inspiratory], R_E [expiratory], R_{tot} [total] were calculated by the computer using the least mean square technique.[15] Measurements of R were not corrected for endotracheal-tube size.[16] Pulmonary graphics were carefully screened to assure that only mechanical breaths were accepted, a minimum of 10 breaths were needed to be considered a complete test. Any spontaneous breaths or breaths showing spontaneous asynchrony with the ventilator were rejected (Fig. 1).[16]

Functional residual capacity (FRC) was measured with a closed-circuit helium-dilution technique.[17,18] This circuit is adapted to maintain ventilator support, if necessary, during the measurement of FRC. The helium concentration subsequently decreases during a 90-second period of mechanical ventilation at a rate that is dependent on the infant's FRC. Because air leaks around the endotracheal tube can influence the amount of decline in the helium concentration, the helium decay curve is corrected for losses due to endotracheal tube air leak, and a final helium concentration due only to the infant's FRC is calculated.[18] The average of 2-3 measurements was recorded. The child was returned to the regular ventilation circuit for at least 10 minutes between measurements and after testing was completed.

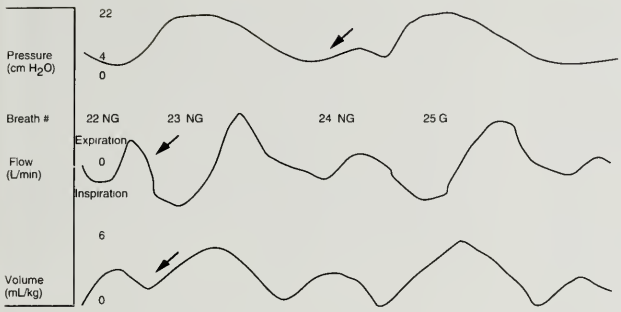

Fig. 1. Breaths numbered 22 and 23 are rejected due to spontaneous breathing and mechanical asynchrony. Arrows point to inspiratory flow of 23 beginning before the spontaneous breath is completely exhaled. Breath 24 is a spontaneous breath detected by the pressure decreasing below baseline. Breath 25 is an acceptable mechanical breath. NG = not good (not accepted) and G = good (accepted).

Protocol

Each infant's vital signs (including heart rate and oxyhemoglobin saturation) were monitored throughout the testing procedure. Pulmonary function tests were performed before (PRE) and 20 minutes after (POST) administration of the bronchodilator.[17] One actuation (90 μg) albuterol sulfate was given by metered-dose inhaler (MDI). The MDI was situated in the circuit immediately proximal to the endotracheal tube using an MDI adapter. We ventilated the infants with a flow-inflating resuscitation bag during drug delivery. A photograph of this assembly is provided in Figure 2.

Data Analysis

Infants were grouped according to their POST R_{tot} as (1) positive responders when they exhibited at least a 25% decrease; (2) nonresponders when they had less than a 25% change; and (3) negative responders when they had more than a 25% increase. We compared gestational age and study age among the groups using 1-way analysis of variance (ANOVA). The PRE and POST changes in minute ventilation ($\dot{V}_E$), and R_I, R_E , and R_{tot} were compared among the groups using 2-way ANOVA. Significant ANOVA models were subjected to Scheffé's post-hoc test. A p value less than 0.05 was considered statistically significant.

Results

Study infants were stable at the time of testing and remained so throughout the testing period. Heart rate was monitored and a 3-4 beat/min increase was consistently seen following albuterol sulfate. Three infants experienced an increase in heart rate from baseline 162, 168, and 172 beats/min to 181, 188 and 196 beats/min respectively, following the albuterol treatment. There were no other changes in vital signs including oxyhemoglobin saturation measured by pulse oximeter in any of the infants studied.

The PRE and POST tidal flow-volume loops from an infant with a positive response to albuterol are displayed in

Fig. 2. This is a photograph of a resuscitation bag with a metered-dose inhaler and adapter connected to an endotracheal tube, as used to deliver bronchodilator in our evaluations.

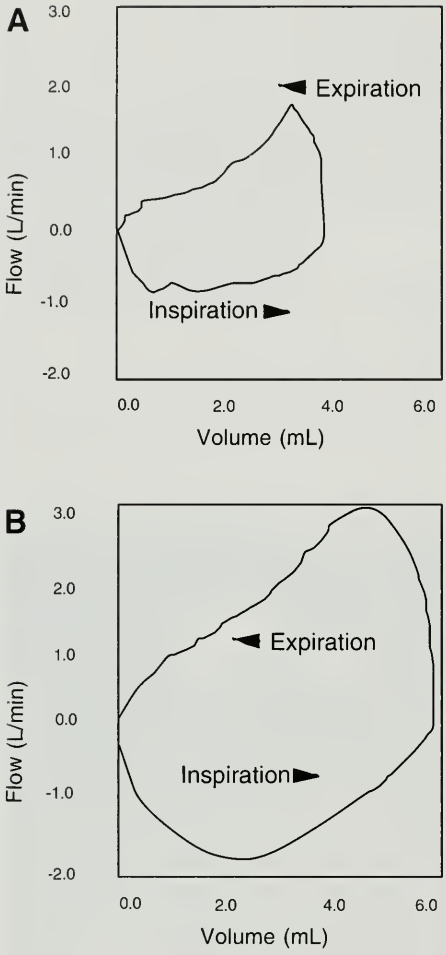

Fig. 3. These tidal flow-volume loops are based on mechanical breaths from the infant with the most dramatic positive response. Before bronchodilator = A, and 20 minutes after bronchodilator = B. Note the increase in tidal flow and volume, after bronchodilator.

Figure 3. The increase in peak flow from 1.6 to 2.9 L/min was associated with an increased tidal volume from 2.8 to 5.9 mL in this particular infant. The tidal flow-volume relationship PRE and POST for an infant with no response is shown in Figure 4. As shown, evidence of TBM PRE is exacerbated following albuterol therapy to the point of early airway airway closure, which can be seen in the expiratory phase of the tidal flow-volume loop, where expiratory flow approaches zero midway through the tidal volume. On tidal flow-volume analysis 4 infants in the no-response group and 2 infants in the negative-response group demonstrated obstructive flow patterns consistent with TBM with increasing flow limitation at POST. There were also 4 infants in the positive-response group with similar flow tracings PRE that improved following bronchodilator therapy.

PRE and POST values for the entire study sample are displayed in Table 1. There was a significant change in R_E following albuterol therapy.

Table 1. Pulmonary Function Profile of the Study Sample of 25 Premature Infants. Values Are Mean (SD).

	PRE Treatment	POST Treatment
Minute ventilation ($mL \cdot min^{-1} \cdot kg^{-1}$)	335 (150)	344 (165)
Dynamic compliance ($mL \cdot cm\ H_2O^{-1} \cdot kg^{-1}$)	0.47 (0.18)	0.50 (0.19)
Resistance ($cm\ H_2O \cdot s \cdot L^{-1}$)		
Inspiratory	129 (88)	109 (86)
Expiratory	205 (146)	154 (76)
Total	146 (87)	131 (84)
Functional residual capacity (mL/kg)	24 (9)	25 (6)

* Significantly different from PRE, $p < 0.05$

A pulmonary function and demographic profile of the infants grouped by response is presented in Table 2. Forty percent of the patients tested had a 25% improvement in R_{tot} POST when compared to PRE values. These same patients had the highest R_I and R_E values PRE. The infants who had a negative response accounted for 24% of the study sample. These babies were more likely to have an initially lower resistance than either the positive-response or the no-response groups. There were no differences in C_{dyn} or FRC between groups, or following albuterol therapy within groups.

Discussion

The infants in this study were clinically suspected of having bronchospasm at the time of the study because of audible wheezing, failure to wean, retained secretions, and radiographic evidence of migratory atelectasis. Our data indicate that only 40% of these intubated preterm infants responded positively to inhaled bronchodilator therapy with a > 25% improvement in R_{tot} POST, whereas 24% responded with an increased R_{tot} POST. Thirty-six percent of the

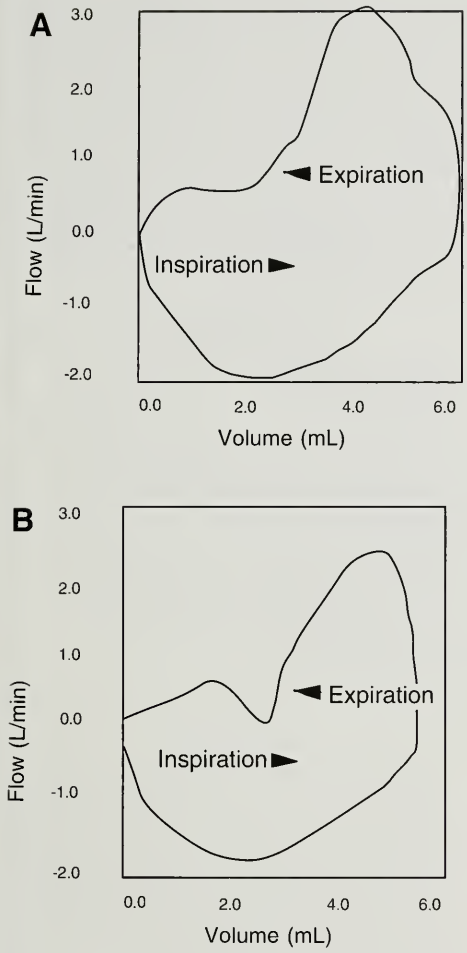

Fig. 4. Typical mechanical tidal flow-volume loops from an infant who had no response to inhaled bronchodilator therapy. Panel (A) is before bronchodilator (PRE), and panel (B) is 20 minutes after bronchodilator (POST). Note the slight loss in tidal volume. Peak flow occurs sooner and is reduced. The flow limitation POST suggests tracheobronchomalacia in this infant.

study population demonstrated no change in R_{tot} from their PRE test. Therapy was discontinued in the latter 2 groups because it was shown to be either a deleterious or an ineffective treatment for these patients. Several infants with minimal or negative response to bronchodilator therapy demonstrated TBM, certainly an unwanted response, on their POST tidal flow-volume analysis that had been previously undetected.[16,19] If TBM is the cause of the abnormal lung findings, therapeutic relaxation of the bronchial smooth muscle could further limit flow to the point of airway closure that may render the wheezing inaudible. This finding is demonstrated in Figure 4. It should be mentioned that tidal flow-volume loop analysis can only suggest TBM, as 4 infants in our positive-response group did reveal end-expiratory flow limitation consistent with TBM before bronchodilator that cleared or improved after treatment. With these results in mind, we can justify a trial of bronchodilator therapy. However, a worsening condition following bronchodilator therapy is stronger evidence that TBM exists, and visual inspection of the airway via bronchoscopy would confirm this diagnosis.[20]

There are several anecdotal reports that support the use of bronchodilator therapy in preterm infants with apparent chronic lung changes.[3,4,21] Conversely, other authors have shown negative responses to inhaled bronchodilators, with some reporting increased R_{tot} values lasting up to 15 minutes.[22] Others have demonstrated paradoxical decreases in maximum flow at FRC with forced expiratory maneuvers, while resistance decreased following bronchodilator therapy.[23]

Table 2. Pulmonary Function and Demographic Profile of Infants Grouped by Response. Values Are Mean (SD).

	Positive Response	No Response	Negative Response
n	10	9	6
Gestational age (weeks)	28 (5.1)	27 (3.7)	28 (5)
Study age (weeks)	6 (4.9)	9 (5)	5 (2)
Minute ventilation ($mL \cdot min^{-1} \cdot kg^{-1}$)			
PRE	281(114)	392(179)	342(145)
POST	321(145)	333(118)	399(255)
R_I ($cm\ H_2O \cdot s \cdot L^{-1}$)			
PRE	168(103)	120(79)	75(39)
POST	78 (54)	152(121)	96(13)
R_E ($cm\ H_2O \cdot s \cdot L^{-1}$)			
PRE	233 (131)	229 (186)	121 (67)
POST	142 (47)	174 (104)	142 (73)
R_{tot} ($cm\ H_2O \cdot s \cdot L^{-1}$)			
PRE	177 (64)	161 (104)	74(57)
POST	110 (47)	157 (108)	126 (97)

*Significantly different from PRE , $p < 0.05$; PRE = before and POST = after bronchodilator; R - resistance, I = inspiratory, E = expiratory, and tot = total.

Our findings suggest that inhaled bronchodilators can reduce airways resistance in selected preterm infants with persistent ventilator dependency. However, clinically, it is difficult to predict which infants are most likely to respond to this therapy. The compromised airway of a premature baby may demonstrate clinical findings mimicking bronchospasm, yet, symptoms may not be relieved by bronchodilator therapy. The narrow airway of an infant can produce wheezing sounds when partially occluded by mucosal edema, secretions, or TBM.[24,25] In addition to the direct effect of albuterol on bronchial smooth muscle, bronchodilator administered by small-volume nebulizer may affect other components of lung function, which subsequently alter R_{tot}. Cool aerosolized saline introduced into the trachea may affect airway secretions and tone, as well as change FRC or C_{dyn} (ie, by altering gas trapping), and indirectly change R.[6] The stability of our measurements of FRC and C_{dyn} PRE and POST gives us confidence in the reliability of our measurements of R.

Pulmonary function analysis may assist in predicting which infants will not respond to bronchodilators prior to therapy. A pulmonary function test performed PRE revealing R_{tot} values near predicted normal may suggest the likelihood of a negative response to bronchodilator. The infants in our the negative-response group tended to have lower R_E before aerosol. Because of the small number of patients in each group, we did not have enough statistical power to demonstrate a significant difference if one existed and must relegate the differences we observed to chance. However, we believe the differences may not be due to chance alone. In addition, the suggestion of TBM found during tidal flow-volume analysis either before or after bronchodilator therapy may indicate a need for other diagnostic and/or therapeutic procedures. Symptoms of increased airway reactivity in ventilated preterm infants may be otherwise clinically indistinguishable from fixed airway obstruction or TBM. Measurement of lung function is effective in defining the pathophysiology of a suspected airway abnormality. Routine pulmonary-function testing PRE and POST bronchodilator may help in avoiding potentially harmful or ineffective use of this therapy in the intensive-care nursery, particularly when such evidence is taken together with the physical exam and patient history.[26]

Conclusion

We reviewed pulmonary function data from 25 intubated premature infants who had varied responses to inhaled bronchodilator. Our testing is based on tidal breathing, certainly not the most sensitive method of pulmonary function testing.[27-29] The development of more sensitive, less invasive tests and equipment are needed. We administer bronchodilators directly into the endotracheal tube, recognizing that only a small percentage of the medication is actually deposited in the airways.[9,30] Nonetheless, this small dose was enough to elicit an airway response, positive and negative, in 64% of our patients. It is not the intention of this paper to suggest that infants who do not respond positively to bronchodilators today be denied future trials of such medications. We are suggesting that the use of bronchodilators in infants should be evaluated to document that the response is desirable, because an unwanted response may be subtle. Dose-related research is needed. The manufacturers of bronchodilators do not provide dose information for children in this age group.

PRODUCT SOURCES

Pulmonary Function System:
PEDs, PTI Inc, Hatboro PA
PANDA, PTI Inc, Hatboro PA
Pressure Transducers:
p7d, Celesco Transducer Products Inc, Canoga Park CA
MP45, Validyne Engineering Corp, Northridge CA
Pneumotachograph:
Fleisch 00, OEM Medical, Richmond VA
Esophageal Catheter:
8 Fr, Baxter Healthcare Corp, Deerfield IL
Metered-Dose-Inhaler Adaptor:
RTC 22A, Instrumentation Industries, Bethel Park PA
Flow-Inflating Resuscitation Bag:
0.5L, Vital Signs Inc, Totowa NJ
Statistical Analysis Software:
Systat v. 5.0, Systat Inc, Evanston IL

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The Status of Research Instruction in Advanced Respiratory Care Practitioner Programs: A Survey

Marilyn Childers MEd RRT and Arthur Jones EdD RRT

BACKGROUND: According to a 1992 Delphi study, 75% of respondents considered research interpretation skills important to advanced respiratory care practitioners (ARCPs). Considering that finding, we sought to describe research instruction among ARCP programs. METHODS: After several educators evaluated face validity and readability of the Research Education Questionnaire (REQ), we mailed it to ARCP programs in the U.S. listed by the Joint Review Committee on Respiratory Therapy Education (JRCRTE). The REQ contains 32 items that together describe types of programs, faculty preparation, and extent to which research instruction is offered. To follow up, we contacted 25 randomly selected nonrespondents by phone 6 weeks after the initial mailing. Descriptive statistics were generated to describe our findings. RESULTS: Sixty-four percent (179/280) responded to the mailed survey. Of 25 telephone contacts, only 6 were available to survey. Of respondents, 16% offer formal courses in research. The most common goals were for students to read and interpret research and statistics. The modal reason for excluding formal research instruction was insufficient time. Of programs without research courses, 69% include journal studies. Of respondents, 72% require students to read research, 26% provide a format to evaluate it. CONCLUSIONS: Formal research courses are largely restricted to BS programs (21/28). Both associate- and baccalaureate-degree programs generally require students to read research and teach them to interpret it. Although our inability to adequately characterize nonrespondents inhibits our ability to validate our sample and, therefore, its responses, the relatively high response rate (64%) lends credence to our results. We believe this research accurately describes the extent to which research concepts are taught in ARCPs and may help guide the development of future guidelines for respiratory care educational programs. [Respir Care 1995;40(2):152-155.]

Background

Because professions are dynamic systems, their viability depends on the continuous input of new information, which is the product of research. Researchers play the very important role of finding and disseminating new information for the profession. Practitioners put research findings into practice. So, it seems that all members of a profession have a stake in the conduct of research.

In January 1992, O'Daniel et al[1] reported the findings from a Delphi study conducted to describe the future educational needs for respiratory care practitioners. One of the findings of that study was that 75% of the respondents considered research interpretation an important skill for advanced respiratory care practitioners (ARCPs). This finding agrees with that of other medical professions advocating research literacy for practitioners.[2]

However, research is not an innate skill. Even minimal skill in research interpretation requires a knowledge of research design and methods and statistical analysis. Therefore, some training is necessary to prepare practitioners to become intelligent consumers of research literature. The educational

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accreditation essentials of other health-care professions (eg, occupational therapy, physical therapy, and physician assisting) require research instruction. However, the Essentials for Respiratory Care Education[3] set down by the Joint Review Committee on Respiratory Therapy Education (JRCRTE) have no requirements for research instruction at any level. In view of the absence of requirements for research instruction in respiratory care education, we were interested in finding the extent to which our educational institutions prepare advanced practitioners to conduct and consume research. The purpose of this study was to describe the existence and scope of research instruction offered in advanced respiratory care practitioner (ARCP) educational programs.

Methods

We designed a questionnaire and submitted it to a group of educators to review for face validity and readability. This instrument consists of 32 items intended to describe ARCP programs, faculty preparation, and research courses. Before the questionnaire was mailed, it and the research protocol were granted facilitated approval by the University's Institutional Review Board (IRB) because of the noninvasive nature of the study and because of our assurance of participant anonymity and confidentiality of their responses.

We mailed the questionnaire to all of the advanced practitioner programs in the United States as listed in the 1994 JRCRTE List of Educational Programs[4] (N = 280). As questionnaires returned, we recorded responses on a computer spreadsheet, which was later used to compute descriptive statistics.

Approximately 6 weeks after the initial mailing, we randomly selected 25 nonrespondents to survey by telephone. The purpose of this step was to validate our sample by testing for differences in survey results between respondents and nonrespondents.

Results

Of the 280 surveys mailed, 179 were returned (64%). Of the 25 randomly selected nonrespondents, we were able to contact only 6 by telephone, even after several attempts. This was an inadequate sample for the planned comparison between respondents and nonrespondents.

The sponsoring institution, type of program, and academic degrees held by program faculty are shown in Table 1. Further, 94% (29/33) of baccalaureate degree programs responded, and 61% (151/247) of associate degree programs completed the survey. We found that 93% (166/179) of faculty from responding programs had some training in research and statistics and that 67% (120/179) had conducted research, although only 13% (24/179) of responding programs require that faculty actively conduct research. Table 2 shows the highest academic degrees held by various faculty members.

Table 1. Description of Sponsoring Institutions and Programs of Survey Responders

Description	n	% of 179 Respondents*
Sponsoring institution		
Community/junior college	122	68.2
4-year college	20	11.1
Public university	19	10.6
University health-science center	15	8.4
Type of program		
2-year advanced practitioner	104	58.1
1+1 advanced practitioner	43	24.0
2+2 baccalaureate	10	5.6
Career-ladder baccalaureate	5	2.8
4-year baccalaureate	19	10.6
Nontraditonal	2	1.1
Degree awarded		
Certificate	27	15.1
Associate	153	85.5
Baccalaureate	30	16.8

*Some of the columns in this table may not add to 100% because not all of the survey items were answered or because more than one answer was supplied by one respondent (eg, several programs offer more than one degree).

Table 2. Academic Degrees of Program Faculty Responding to the Survey

Highest Degree Attained	n_i*	% of n
Program director (n = 179)		
Associate	6	3.4
Baccalaureate	48	26.8
Master	99	55.3
Doctorate	23	12.8
Other faculty (n = 590)		
Associate	147	24.9
Baccalaureate	226	38.3
Master	169	28.6
Doctorate	49	8.3

* $\sum_{i=1}^{n} n_i = n$

The programs that required students to take formal research courses represented about 16% (28/179) of the respondents. Of these programs, 21/28 were baccalaureate-degree programs. The research-methods courses are taught by RC faculty in 36% of the programs (10/28), and statistics courses are taught by RC faculty in 33% of them (9/28).

Table 3 shows the terminal objectives of the research courses taught, and Table 4 shows the types of research covered. Tables 5 and 6 describe the terminal objectives of statistics coursework and the types of statistics taught.

Table 3. Terminal Objectives of Research-Methods Courses

Objectives	n	% of 28 Respondents
Read research literature	28	100.0
Interpret findings from literature	26	92.9
Evaluate research methods and literature	24	85.7
Assist in conducting studies	16	57.1
Conduct studies independently	13	46.4
Design studies	15	53.6

Although programs reported the use of a variety of texts, the modal text (5/28) was "Fundamentals of Respiratory Care Research," edited by Chatburn and Craig.[5] The most common statistics software (4/28) used in formal statistics coursework was Statistical Package for the Social Sciences.[6]

Table 4. Types of Research Addressed by Research-Methods Courses

Topics	n	% of 28 Respondents
Literature search and review	25	89.3
Surveys	18	64.3
Case control studies	13	46.4
Observational studies	15	53.6
Clinical trials	21	75.0
Device/method evaluation	16	57.1
Retrospective analysis	19	67.9
Qualitative analysis	8	28.6

We asked respondents to indicate minimal research requirements for students. The possible responses ranged from students' completing literature reviews to conducting their own studies. Of respondents, 100 (28/28) require a literature review at minimum and 54% (15/28) require students to design a study. Students observe or assist research in 43% (12/28) of these programs and conduct research in 33% (9/28) of them.

Table 5. Terminal Objectives of Statistics Courses

Objectives of Statistics Coursework	n	% of 28 Respondents
Hand-calculate statistics	15	53.6
Use statistics software	10	35.7
Select appropriate statistics	19	67.9
Interpret statistical results	23	82.1

Table 6. Types of Statistics Addressed by Statistics Courses

Statistics Coursework Taught	n	% of 28 Respondents
Descriptive	25	89.3
Parametric inferential	16	57.1
Correlation/Regression	20	71.4
Nonparametric inferential	6	21.4

Eighty-four percent (151/179) do not require formal research or statistics coursework. Table 7 summarizes the respondents' reasons for excluding research from curriculum. Of those programs excluding formal research instruction from their curriculum, 69% (104/151) include informal studies of research in which 37% (38/104) scrutinize research methods, and 20% (21/104) address statistical analysis. The stated primary objectives of these studies are to enable students to comprehend and interpret the literature. Furthermore, 96% (100/104) of these respondents offering informal instruction require their students to read research articles, and 32% (33/104) expose their students to research in progress. This exposure involved observing (94%, 31/33), assisting (38%, 13/33), and participating as subjects (58%, 19/33). Table 8 shows the types of research to which these students were exposed.

Table 7. Reasons for Excluding Research from Curriculum

Reason	n	% of 151 Respondents
Insufficient time	99	65.6
Inappropriate for education level	34	22.5
Not an institutional goal	21	13.9
Not important for graduates	7	4.6
Lack of faculty expertise	2	1.3
Too difficult for students	2	1.3

Of all respondents 72% (128/179) require students to read research. Respondents reported spending an average (SD) of 14.9 (13.4) hours (range 1-90 hours) reviewing research literature and 26% indicated that they provide their students with a form to help them analyze research literature. Several respondents stated that they would implement the use of such a form in the future.

Table 8. Research Exposure in Programs without Formal Courses in Research

Types of Research Exposure	n	% of 47 Respondents
Clinical experimentation	33	70.2
Survey research	20	42.6
Method/device evaluation	21	44.7
Descriptive/retrospective analysis	9	19.1
Case-control study	14	29.8

Discussion

Until recently, ARCP instructors with master's degrees were relatively rare. However, our data show that graduate degrees are now common in this group. Furthermore, the majority of ARCP faculty from responding programs have completed research courses (92%) and conducted some type of research (66%). This is in contrast to a 1988 study that reported a scarcity of such expertise among our educators.[8]

The proportion of responding programs with formal research preparation for students is 16%. Baccalaureate-degree programs represent 75% (21/28) of these, leaving a large proportion of entry-level RCPs without formal training in research.

The most common reason among respondents for excluding formal research courses was insufficient time. The faculties of 2-year programs are in a particularly difficult position in this respect. In addition to the academic courses required by their institutions, they must find time in their curriculum to teach an ever-expanding array of equipment and skills in a brief 2 years. Furthermore, they are limited by the number of credit hours that they can require for a 2-year degree. Nearly all the programs without formal research courses have an informal mechanism to encourage research literacy. The responses to this survey indicate support among responding RC faculty for promoting research literacy among RCPs. A majority of programs require their students to read research literature, but few provide any structure for this activity.

We believe that providing a review format, like RESPIRATORY CARE's reviewer checklist,[7] helps students focus on the important points of research. The primary limitation of our study is clearly our inability to characterize the nonresponders.

Conclusions

Despite the absence of accreditation requirements to include research interpretation in ARCP curricula, our findings suggest that nearly all respiratory care educators make some effort to teach research literacy. Although we were not able to validate our sample by characterizing the nonresponders, our 64% response is high and lends credence to our results. Formal research courses are taught in baccalaureate-degree programs more often than in associate-degree programs. The latter, constrained from adding additional courses, use informal mechanisms for research instruction. These data may be useful for developing new guidelines for respiratory care educational programs.

ACKNOWLEDGMENT

The authors are grateful to the participants for taking the time to complete the questionnaire.

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Laboratory Evaluation of Oxygen-Enrichment Methods using a Portable Volume Ventilator

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BACKGROUND: This study examined the effects of oxygen (O_2) delivery methods and ventilator settings on the fraction of oxygen delivered (F_{DO_2}) with a portable volume ventilator. DEVICE DESCRIPTION: The Aequitron Medical LP6 is microprocessor-controlled but without an accumulator to provide supplemental O_2. METHODS AND MATERIALS: O_2 at 0.5, 1.0, and 2.0 L/min was (1) bled into the circuit distal to the bacteria filter (B), (2) entrained into the air-inlet filter using an O_2 adapter (A), (3) entrained into the air-inlet filter using an O_2 adapter with a reservoir (AR), and (4) provided by the manufacturer's O_2-enrichment kit (EK). F_{DO_2} was measured with a calibrated O_2 analyzer and recorded at ventilator rates of 10, 12, and 14 cycles/min with 0.5- and 1.0-L tidal volumes (V_Ts). Multi-way analysis of variance and Fisher's post-hoc test were used to compare F_{DO_2}s among methods. RESULTS: Over all ventilator rate-V_T combinations and O_2 flowrates, the mean (SD) F_{DO_2} and low-high ranges were B = 33.5 (6.57)%, 25-48%; A = 26.0 (2.25)%, 23-30%; AR = 31.6 (4.82)%, 25-40%; and EK = 33.6 (7.86), 22-53%. Method B produced the most inconsistent F_{DO_2} and increased V_T (up to 25%) and peak-inspiratory pressure. These variations were not observed with any of the other methods. For all methods at all settings and O_2 flows, F_{DO_2} decreased as V_T increased but not as rate increased. Difference in F_{DO_2} among the 4 O_2 enrichment applications was significant ($p < 0.005$). CONCLUSION: Methods AR and EK provide higher and more consistent F_{DO_2}s with less effect on V_T and peak pressure than other methods tested. However, when supplemental oxygen is administered by any of these methods, intermittent O_2 and minute ventilation monitoring is necessary. [Respir Care 1995;40(2):156-161.]

Background

Most portable mechanical ventilators used in the home are adjustable to accomodate varying patient needs for ventilation but are not usually equipped with an oxygen (O_2) regulator to provide consistent and precise fractions of delivered oxygen (F_{DO_2}). At present, methodologies for enriching F_{DO_2} and, thus, the fraction of inspired oxygen (F_{IO_2})—O_2 adapters, reservoirs, and accumulators—in home care ventilators generally provide the range (up to 35-45%) and accuracy (±5%) required in the stable long-term ventilator-dependent patient.[1] Aquetron Medical, manufacturer of the model LP6 ventilator,* recommends two O_2-enrichment methods.[2] Oxygen may be bled into the circuit or, it may be entrained into the air-inlet filter by means of an O_2-enrichment kit (Fig. 1). However, other innovative alternative O_2-delivery methods available—O_2 adapters with and without reservoirs—may be just as effective as the conventional methods, but without the added cost and maintenance associated with them. This study

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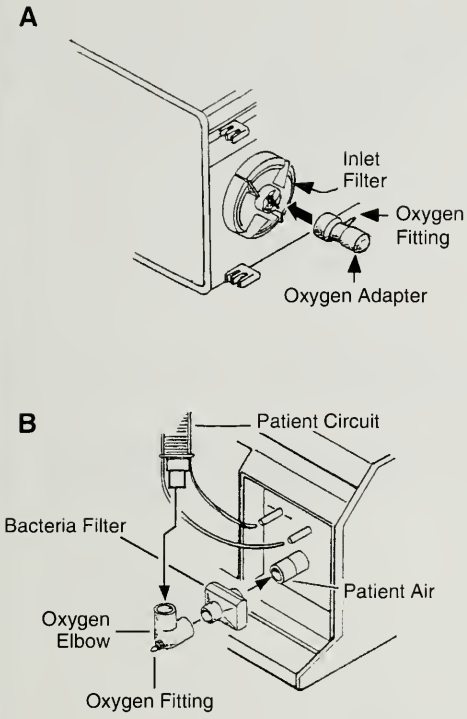

Fig. 1. Oxygen administration sites of the Aequitron Medical LP6 portable volume ventilator. (A) O_2 adapter at the air-inlet filter and (B) O_2 adapter in-line distal to the bacteria filter.

was designed to evaluate various methods of O_2 enrichment using the LP6 volume ventilator and to examine the effect of changing various ventilator settings on F_{DO_2}.

Materials and Methods

Ventilator Description

The LP6 is intended for patients requiring continuous respiratory support in the home, hospital, or during inter- and intrahospital transport. It is a microprocessor-controlled, electronically powered volume ventilator that can be time- and pressured-triggered and volume- and pressure-cycled. The scope of this paper does not permit a detailed discussion of the LP6's operation; however, a simplified explanation may help to clarify study design and results.

A 110-V power source was used in the study to prevent voltage fluctuations during operation even though ventilator power may originate from one of three sources: AC power, the internal battery, or an external battery.

An electronically controlled mechanical piston-pump assembly delivers a preset tidal volume (V_T) from 0.1 to 2.2 L. This volume is set by a push-and-turn potentiometer on the front panel that sets piston excursion. V_T is adjusted electronically by a computer chip that controls the length of the return stroke. The negative pressure caused by the withdraw stroke of the piston generates air entrainment into the LP6 through a 0.3 micron inlet filter located on the rear panel.[2]

All ventilator modes are controlled by the system's microprocessor. When the ventilator is in the assist-control mode (A/C), the microprocessor reads the switch position and related controls (ie, volume, breathing rate, inspiratory time [t_I], and breathing effort) and initiates the appropriate action. In response to a patient's lung compliance and resistance, the microprocessor computes a 'best-guess' speed-control level,when a volume-inspiratory time combination is set. Flow is set by volume and t_I while the exhalation time (t_E) and the resultant I:E are determined by the rate and t_I. If t_I is set greater than t_E, a setting error audio-visual alarm is activated, and the ventilator operates at a default I:E of 1:1.

Evaluation Method

Three LP6 ventilators were professionally serviced according to the manufacturer's protocol and specifications for periodic maintenance. I compared the mechanical variability among them to ensure proper function with regard to all study variables.

The A/C mode was used throughout the study, and the patient breathing-effort trigger and ventilator alarms were set to provide optimal ventilator function without affecting study variables. The t_I was held constant at 2.0 s throughout the study. The ventilator circuit—a manifold nebulizer set—was connected by the O_2 analyzer from the LP6 to a lung simulator (compliance 0.02 L/cm H_2O, and resistance 5 cm $H_2O \cdot s \cdot L^{-1}$). The analyzer was calibrated on 100% O_2 and room air.

Ventilator rates of 10, 12, and 14 cycles/min were combined with 0.5 and 1.0 L V_Ts. These rates and V_Ts are normally appropriate for patients who weigh 50-100 kg (110 to 220 lbs). Baseline V_Ts, measured by a Wright Respirometer, did not vary more than ± 0.01 L.

Using 4 methods of O_2 supplementation (1) O_2 bled into the circuit (B), (2) O_2 entrained into the air-inlet filter

Table 1. Measured Oxygen (%) from Three Oxygen-Enrichment Methods using a 0.5-L Tidal Volume.

Rate (cycles/min)	Oxygen-Enrichment Methods											
	O_2 Bled into Circuit O_2 Flow (L/min)			O_2 Adapter O_2 Flow (L/min)			O_2 Adapter & Reservoir O_2 Flow (L/min)			O_2-Enrichment Kit O_2 Flow (L/min)		
	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0
10	27.7	34.4	46.7	24.6	26.9	29.9	30.3	35.9	40.3	31.3	39.1	52.6
12	27.0	32.7	42.7	24.5	26.7	30.1	29.0	35.0	40.0	29.5	36.4	47.4
14	26.5	31.5	40.0	24.5	26.7	30.0	28.1	34.5	39.3	28.1	34.4	43.1

Table 2. Measured Oxygen (%) from Three Oxygen Enrichment Methods using a 1.0-L Tidal Volume.

Rate (cycles/min)	Oxygen-Enrichment Methods											
	O_2 Bled into Circuit O_2 Flow (L/min)			O_2 Adapter O_2 Flow (L/min)			O_2 Adapter & Reservoir O_2 Flow (L/min)			O_2-Enrichment Kit O_2 Flow (L/min)		
	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0
10	27.7	33.4	42.9	23.3	24.8	26.9	26.1	29.0	31.6	25.6	29.7	36.5
12	26.3	31.5	40.6	23.3	24.8	26.9	25.4	28.6	31.7	24.7	28.3	34.8
14	25.5	30.3	36.7	23.2	24.7	26.9	25.1	28.1	31.1	24.2	27.2	32.7

using an O_2 adapter (A), (3) O_2 entrained into the air-inlet filter using an O_2 adapter with a 50-mL reservoir (AR), and (4) the manufacturer's O_2-enrichment kit (EK), O_2 flows of 0.5, 1.0, and 2.0 L/min were each administered at all rate-V_T combinations. These O_2 flowrates were chosen because they provide F_{DO_2}s within the range usually required by home ventilator patients using the above rate-V_T combinations.[3] O_2 was supplied by a calibrated 0-3 L flowmeter.

During ventilator cycling, O_2 measurements fluctuated at peak inspiration and end exhalation and also varied from one ventilator cycle to another. The 3 highest and lowest O_2 measurements measured during ventilator cycling that were within 0.3% of each other, were used to define the average peak-inspiration high and end-exhalation low F_{DO_2}. These data were averaged and expressed as F_{DO_2} range limits for each O_2 flowrate-ventilator combination. The mean F_{DO_2} is the average of the high and low range limits for each O_2 flowrate-ventilator setting combination for each ventilator. F_{DO_2} values for all 3 ventilators were then averaged to determine the mean F_{DO_2} values for each O_2 flowrate-breathing rate-V_T combination.

Data Analysis

Data were analyzed with multi-way analysis of variance and Fisher's post-hoc test. Null hypotheses were rejected (compared means were considered significantly different) at $p < 0.05$.

Results

The mechanical variability of the ventilators was not statistically significant ($p = 0.9$). Tables 1 and 2 present F_{DO_2}s measured with the 4 O_2-enrichment methods evaluated at various ventilator rate-V_T-O_2 flowrate combinations ($p < 0.001$ for all pairwise comparisons). In these tables, comparisons at 1.0 and 2.0 L/min O_2 flowrates revealed that the greatest contrast was between Method B and all other methods. The differences in F_{DO_2} among these methods ranged from 3.6 to 17.7 percentage points. When A was compared to AR, the differences in F_{DO_2} ranged from 2.2 to 9.2 percentage points, although the least difference was found between the F_{DO_2} values of AR and B at 1.0 and 2.0 L/min O_2 flow—2.2 to 8.5 percentage points.

Analysis of the F_{DO_2} ranges for each ventilator indicated that B produced the largest peak-inspiration and end-exhalation F_{DO_2} fluctuations over all rate-V_T-O_2 combinations. The largest range of F_{DO_2} was provided by EK (22-53%). A produced the smallest F_{DO_2} range (23-30%) with the least fluctuation over all settings combinations ($p < 0.001$). AR provided F_{DO_2}s that were similar to those of the B (26-40%) but without the high F_{DO_2} fluctuations associated with B.

As the V_T was increased from 0.5 to 1.0 L, the F_{DO_2} decreased at all ventilator rates, regardless of the O_2-enrichment method. Figure 2 shows F_{DO_2}s measured during V_T comparisons of the 4 O_2 enrichment methods ($p < 0.005$ for all pair wise comparisons). The largest F_{DO_2} difference between V_T comparisons was observed with EK (–13 percentage points) followed by AR (–8.3), A (–3.1), and B (–3.0).

As the ventilator rates increased, F_{DO_2} values decreased for both V_Ts and over all O_2 flowrates with B and AR. However, F_{DO_2} values remained within 0.2% of each other when A was used.

EK provided the highest F_{DO_2} of all the methods evaluated at each rate-V_T-O_2 flowrate combination except Method B at a 1.0-L V_T.

Discussion

In the United States, increasing numbers of patients requiring chronic ventilatory support are residing at home.[4] However, patients with severe pulmonary disease who require ventilatory support are usually more difficult to manage at home than those who require ventilation because of neuromuscular disease due to the requirement for adjustments in ventilation and F_{DO_2} during acute exacerbations of their pulmonary disease.[5] The ability to accommodate the needs of such patients may reduce the necessity for hospitalization. While most home-care portable ventilators provide the range of F_{DO_2} required for the stable patient, the O_2-delivery method may need to be changed to accommodate acutely ill patients requiring a higher and more precise F_{DO_2}.

This study has shown that the F_{DO_2} range may vary from one method of O_2 delivery to another. When Method

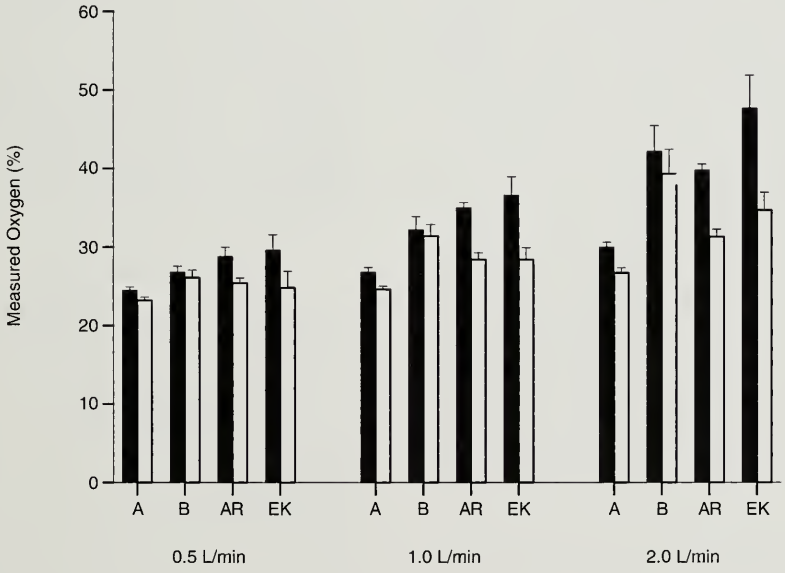

Fig. 2. Mean measured oxygen (% + SD) of 4 O_2-enrichment methods at 0.5-L (black bars) and 1.0-L (white bars) tidal volumes (V_Ts). n = 9 for each O_2 flowrate and V_T combination. ($p < 0.005$ for all pairwise comparisons). A = adapter only, B = O_2 bled into the circuit, AR = Adapter with a 50-mL reservoir, and EK = the manufacturer's O_2-enrichment kit.

A was used, F_{DO_2} increased only 4.5 percentage points with a 0.5 L V_T and 3.6 percentage points with a 1.0 L V_T as O_2 flowrate increased from 0.5 L/min to 2.0 L/min. However, when O_2 was bled into the circuit, the F_{DO_2} changed as much as 16 percentage points. When the need for higher F_{DO_2}s arises, the choice of O_2-enrichment method is clear.

Difficulty in maintaining a consistent F_{DO_2} at a given ventilator setting using Method B was evidenced by the fluctuation of F_{DO_2} at peak inspiration and end exhalation, especially at higher O_2 flowrates. The increased O_2 volume in the circuit (functionally a volume reservoir) may be inadequately mixed with the room air entrained by the ventilator as it cycles, resulting in the O_2 fluctuations and inconsistent F_{DO_2}s.

Whereas baseline V_Ts did not vary with the O_2 flowrates with Methods A and AR, the extra O_2 volume bled into the circuit resulted in a 25% increase in the V_T at 0.5 L and a 11% increase at a 1.0-L V_T. Also noted was a 1-2 cm H_2O [0.098 kPa-0.196 kPa] increase in peak-inspiratory pressure when 1.0 and 2.0 L/min O_2 flowrates were bled into the circuit. Hanhan and associates[6] reported increases in minute ventilation, peak-inspiratory pressure, and positive end-expiratory pressure with the additional flow generated by in-line nebulization. They concluded that tidal volume can become excessive resulting in complications and must be continuously monitored. Whereas fluctuations in volume and pressure may be well tolerated by some patients, they may place other patients at risk for serious complications.[7,8] Again, the choice of O_2-enrichment method may be critical for certain patients with pulmonary disease who are at risk for complications.

To address need for a high and consistent F_{DO_2} and avoid the expense of EK (approximately $89), a 50-mL section of corrugated tubing was added to the air-inlet adapter as a reservoir—AR. The increase in F_{DO_2} observed with this method may have been due to the extra O_2 volume held in the tubing. Using AR and a 0.5-L V_T, the F_{DO_2} measurements were greater than the F_{DO_2} measurements taken at a 1.0-L V_T. This is likely due to the decreased O_2-air ratio and the increased room-air volume entrained into the inlet filter when the 1.0-L V_T was set. F_{DO_2}s achieved using EK and AR were similar except at the 2 L/min O_2 flowrate where the difference was 7.8 percentage points with the 0.5 L V_T and 3.1 percentage points with the 1.0 L V_T. In this case, EK produced the higher F_{DO_2}.

The patient circuit, acting as an enclosed reservoir, should provide the highest F_{DO_2} values of all 3 methods. Although the F_{DO_2} values of Method B with a 1.0-L V_T (ie, O_2 flowrates of 0.5 and 1.0 L/min over all breathing rates) were higher than the F_{DO_2} values of AR, this effect was not observed when a 0.5-L V_T was set. In an attempt to explain these observations, I connected a pressure manometer to the O_2 supply tubing and observed a 2-3 cm H_2O pressure deflection during the ventilator cycle at both 0.5 and 1.0 L/min O_2 flowrates. Based on these data, I speculate that the gas velocity during inspiration may inhibit the 'bleed rate' of O_2 flow into the circuit, causing an intermittent decrease in F_{DO_2}. However, the exact cause of this phenomenon is not known.

Conclusion

The available literature on the evaluation of O_2-enrichment methods on portable ventilators is limited. For stable patients, where the need for high and precise F_{DO_2}s may be limited,[9] the O_2 adapter with a reservoir tube placed at the air-inlet filter may be an inexpensive alternative to the manufacturer's O2-enrichment kit. This method provided better O_2-air mixing and a more stable F_{DO_2} range with the least amount of O_2 fluctuations during ventilator cycling without increasing minute ventilation or peak-inspiratory pressure.

Limitations to the O_2 adapter method are apparent and include the need for a high and precise F_{DO_2} during periods of acute respiratory illness. While both EK and AR provide high and stable F_{DO_2}s, AR is less expensive, and may be more adaptable in certain circumstances (eg, narrow wheelchairs and shopping carts).

Although B provided high F_{DO_2}s, this method increased V_Ts and pressures, exhibited greater F_{DO_2} variation during ventilator cycling, and therefore, cannot be recommended.[3]

Regardless of the O_2-enrichment method used, intermittent O_2 and minute ventilation monitoring is essential during supplemental O_2 administration and following adjustments of the mechanical ventilator.

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PRODUCT SOURCES

Ventilator:
LP6, Aequitron Medical Inc, Minneapolis MN
Wright Respirometer:
IdE Mark 8, Ferraris Medical, Holland NY
Flowmeter:
Classic 0-3, Timeter Corporation, Lancaster PA.
Oxygen Analyzer:
Miniox I, Catalyst Research Corporation, Owings Mills MD
Lung Simulator:
LS 122 (Manley), Bear Medical Systems, Riverside CA

Ventilator Circuit:
Manifold Nebulizer Set, Seamless Professional Medical Products, Ocala FL
Airway Pressure Gauge:
Diemolding Healthcare Division (DHD), Canastota NY
Statistical Analysis Software:
Stastical Analysis System v.6 1992, SAS Institute, Cary NC

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RCPs and Health-Care Reform: Demonstrating Value, Creating Opportunity

Kevin Shrake MA RRT

Introduction

In this paper, I address the importance of demonstrating value and creating opportunity—to employers or prospective employers and, increasingly, to consultants and regulatory agencies.

Each of us must be smart; each must plan; each must observe; each must predict and act. We are truly at a crossroads in health care in America. Change is occurring at a rapid pace as it always has in health care, but we are likely to see 15 years of change in the next 18 months. If you are one of those individuals who has to be dragged kicking and screaming through the change process, even if the change is moving the coffee pot from one side of the room to the other, the next few years may be a very distressing period for you. However, if you are flexible, have an open mind, and are willing to be a change agent in working through the issues facing health care, the future can be very bright.

Not since 1964, when the Medicare-Medicaid program was developed, has there been so much attention focused on health care. I have never, in my entire career, been more excited about preparing a paper and lecture than I have been about this one. As I thought about the reasons for that, I decided that the excitement stemmed from the opportunity to provide some advice, some guidance, and a positive outlook during one of the most volatile periods in the history of the American health-care industry. We truly do need to learn how to demonstrate value and create opportunity. To do that, we must have a good understanding of today's health-care system as a basis for making predictions for the future. I present here a number of predictions based on what I have seen, and read, and heard.

Some Predictions

Cost of Health Care

Health-care costs will increase approximately 8-10% as the uninsured become insured.[1] From 30 to 40 million Americans do not have health insurance in our country.[1] Many more citizens are underinsured. To change those statistics, we are going to have to pay—whether that change be incremental or wide-sweeping. We must decide whether we are going to allow our health-care system to continue to refuse to cover pre-existing conditions. That change is going to cost us a lot of money. I have a friend who had a severe heart problem and gastrointestinal bleeding that made multiple surgeries necessary, this past year. Unfortunately, he was between jobs when that happened. Although the insurance carrier from his previous job covered those illnesses, he now has a rider on his insurance policies that lists heart disease and gastrointestinal disease as pre-existing conditions. If any of those problems recurs, he will have some really severe financial problems. That is a big issue in our country.

Insurance companies 'cherry-pick' (ie, they pick out the healthiest individuals in a community and insure them). This is a problem with our system that is going to cost a lot of money to fix. The 'bottom line' is that those individuals (like many of us in this room) who have good health-care insurance now, are likely to continue to have it, but the op-

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tions will change a bit, and coverage will become much more expensive. Those individuals who do not currently have health-care insurance are going to be the big winners in this whole process.

Health-Care Premiums

Health-care premiums will rise only 3-4%,[1] within a health-care market experiencing 8-10% overall inflation. I believe that the main reason for the small rise in premiums is competition and managed care—a fact already being demonstrated around the country in various managed care markets. The national average indemnity monthly premium for health-care costs is around $145. The center bar of the graph (Fig. 1) is a national HMO (health maintenance organization) average of $132 (personal communication, The Advisory Board, The Watergate, 600 New Hampshire Ave NW, Washington DC 20037, 1994). So, HMOs, the so-called competition routine, are helpful in reducing overall costs. The third bar of the graph illustrates a mature HMO market, such as California or the Minneapolis area. The average monthly cost is even less for individuals participating in those markets. So, managed care has been shown to be an effective way to reduce overall cost.

Changing Physician Role

Physicians will join groups and work for salaries. We are seeing this happen already, and the trend will continue. They will integrate (ie, form alliances with other physician groups, hospitals, and insurance companies). The importance of specialists will decrease and the importance of primary-care physicians will increase. Physician salaries will decrease. Some of you have heard me say that with physicians' salaries declining and nurses' salaries increasing, by the Year 2000, doctors will be marrying nurses for their money. The cover stories of modern health-care publications illustrate this changing physician role—"Doctors' Orders Integrate: Physicians Maneuvering To Secure a Key Role in Systems Expected To Dominate Under Reform"[2] and "The Systematic Approach: Physician-Hospital Collaborations Increase—Work to Capture Managed Care Contracts."[3] This type of information about integration floods the health-care literature. Doctors have one of three choices in terms of their overall income in the next few months. One is to make less and work the same. Another is to make the same and work harder. A third is to take ancillary businesses away from hospitals and operate their own laboratories, x-ray units, and so on, to gain some profits in that fashion. The third option has some pitfalls because of legislation that prohibits physicians from referring patients to their own ancillary facilities, such as laboratories.

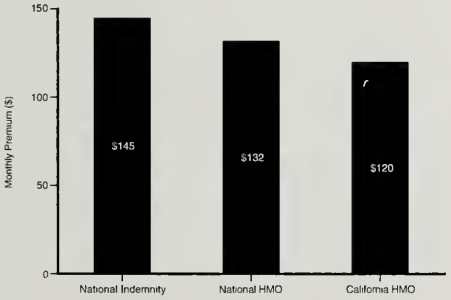

Fig. 1. Average health-care premiums in three different markets in 1994 (Personal communication, The Advisory Board, The Watergate, 600 New Hampshire Ave NW, Washington DC 20037, 1994).

The Government's Role

The government will initiate reform, but it will use HMOs to restructure. Now, we note that the Federal government has initiated reform by *not* initiating reform. That is a bit of irony because we are seeing all of these changes on the state and local level, but it appears that we will not see any major Federal government reform—certainly not in the next couple of years. It seems likely, because of the sweeping victory of the Republican Party across the nation, that any change that occurs will be incremental change. So, the Federal government just 'got the ball rolling,' and now all of these initiatives continue to develop on the state and local level.

Managed Care Alternatives

Only 10-15 of the nation's largest insurance companies will thrive on managed care. Not every little 'Mom and Pop' insurance shop is going to survive the changes that occur. One example of something that is already happening in our industry is provided by Delta Airlines (personal communication, The Advisory Board, The Watergate, 600 New Hampshire Ave NW, Washington DC 20037, 1994). They insure 200,000 employees and channel those with suspected cardiac problems (representing $10 million in cardiac revenue) to 6 preferred provider centers. They have planes, they have pilots, and they have employees with heart disease, and they can fly them anywhere in the country. Perhaps, the communication went something like this, "We are going to select some centers and direct patients to those centers. We are going to provide 100% coverage plus transportation and lodging—if you stay within our system. If you go outside the system, we are going to provide 80% coverage"—certainly a

financial incentive when a bill can total $40-60,000. Delta's headquarters is in Cincinnati, but I do not believe that the Cincinnati hospitals believed that Delta was going to be as aggressive as it turned out. Delta contracted with the Cleveland Clinic to provide that care in the state of Ohio. So, people who live in Cincinnati, are being shipped to Cleveland for their surgery. This is only one example of a steering mechanism that we are seeing develop across the country. HCFA (Health Care Financing Administration) has some of its own initiatives. HCFA has a demonstration project for bypass surgery that has been going on for several years now, in which they have 7 centers throughout the country offering packaged pricing for cardiac surgery (personal communication, LBA Consulting Inc, 6300 S Syracuse Way, Suite 630, Englewood CO 80111, 1994). This pricing ranges from about $25,000 up to $35,000. So, lower cost does not always mean low quality. These centers have had a large volume of business directed to them, and they have very good quality at low cost. The government has been impressed with that demonstration project and will likely try to expand that initiative. The government has not shown an interest in trying to shut down programs. What they do, however, is to set criteria. The program must meet a certain quality standard, a certain volume standard, and a certain cost standard. If the program can meet those standards, then it can participate. The results of that demonstration project are going to cause some problems for some open heart centers around the country, particularly in those areas where there is a heavy concentration of centers.

Response of the Health-Care Industry

The health-care field will vigorously oppose the single-payer system. I do not think the country is ready for this yet—this level of government intervention. The recent elections show not only that we are not ready for a single-payer system but also that we are not ready for total health-care reform and the associated dollar ramifications. Such a system is too costly and too restrictive, and the waiting times are not acceptable to the American public. The Canadian system is often used as a model, but a recent article "Double-Digit Jumps in Costs, Budget Woes Make Highly Acclaimed System a Questionable Role Model," about the Canadian system raised doubts as to its desirability.[4] So, there are problems with Canada's 'model' single-payer system.

Hospitals will 'down-size' or close and middle management and executive positions will be lost. This is already happening—has been happening for several years as many of you are well aware. My own facility had 635 beds in 1988; in 1994 there are 530. In 1997, we are projected to become a 450-bed hospital. Certainly some down-sizing, some cutting, and some restructuring is occurring everywhere, even in the sleepy Midwest.

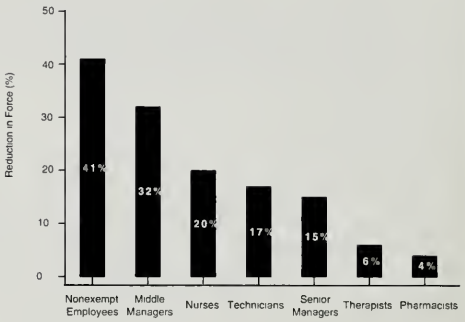

Fig. 2. Reductions in the health-care work force during 1993. (Adapted from Reference 5, with permission.)

Figure 2 shows that 41% of those individuals being cut are nonexempt employees.[5] These are lower-level employees, service-type employees in food and environmental services. Of those being cut, 32% are middle managers. So, certainly, those of us who are in middle management positions have felt the effects of some of these changes. Nurses comprise 20%. That might surprise some of you. There is an overabundance of nurses in some areas of the country, and some of the positions being deleted are nursing positions. So, certainly, there will be a lot of cuts, but the good news is that there is always going to be work for motivated, well-trained individuals—a major theme permeating this paper. The population is aging and a large number of people with cardiopulmonary disease will need care. We must figure out how to position ourselves to secure our future. It is certainly chaotic at the moment. Over time, 40 million Americans will receive some type of universal coverage, but I believe that must happen *over time*. We must find a way to provide that care without devastating our national economy. There will be fewer choices of hospitals and physicians under the managed-care system. There will be a networking, consolidation, and restructuring epidemic. These are wonderful times for consultants. They have much work to do, and they are being paid a large amount of money to assess some of these restructuring situations. We hope that change strategies will stabilize over time, but right now the uncertainty and the mixed incentives present many challenges.

We are still doing a great deal of cost shifting because of Medicare. There are simply not enough dollars in the Medicare system to adequately fund the care that we are providing to that population of people. So, an important fraction of our health-care costs is being shifted from the Medicare side to the private sector, but the private sector is shrinking

and that is a problem. Prices and costs are coming down on that side, and there is less opportunity to shift. We do what we do in any industry because of the existing incentives. We always have, and I guess that we always will. I have been in this field since the early 70s, so I have been through several generations of incentives for what we do. In the golden years of the 1970s, we did as many things to people as we possibly could because the more that we did, the more we were reimbursed. That was the era of intermittent positive-pressure breathing (IPPB). We gave IPPB for everything. We each did 700 IPPB treatments before breakfast. We had to bring the cardiac arrests down to the department so that we could put the resuscitator bag between our knees and squeeze it while we were scrubbing equipment. It was a very busy time. Then the 1980s came along, and in the early 80s the DRG (diagnosis-related groups) system came into play, and we began these in-and-out strategies—Let's bring the people in, let's get 'em out, let's get 'em sick, and let's bring 'em back. It is a good strategy. Then came the 90s, with managed competition coming to the fore. We are seeing the effects and changes from that. The Year 2000 will likely see capitation—a single-payment per year to take care of all the health-care needs of a particular population. We are seeing capitation throughout the country already, but it is likely to be an all-pervasive process by the Year 2000. You can recapitulate these changes, particularly the shrinking time frame in which care is delivered, just by talking to a surgeon. A surgeon interviewing a patient in the 70s and the 80s and the 90s, sounded something like this: In the 70s it would have been, "Mr Jones, have you had anything to eat in the last 24 hours? We need to do surgery on you." In the 1980s it was, "Mr Jones, have you had anything to eat in the last 8 hours? We need to do surgery on you." In the 1990s it has been, "Mr Jones, do you have any food in your mouth right now?"

Management Fads

Management fads like Centers of Excellence and Primary Nursing will not survive reform. These fads have been simply fads. As the incentives change, we must develop systems that fit those incentives, and many of the fads just do not. Hospital care will be administered by a new class of 'clinical executives.' Now, I saw that term in a health-care journal,[1] and I really like it because I think that it describes many of you in the audience. I believe that the combination of clinical and executive skills that many of you have will be useful and will allow you to make a position for yourself in health care.

The Face of Health-Care Reform

So, what will be the nature of health-care reform? It is likely to be just another giant HMO. Results of a survey published in *Modern Health Care* [6] show that HMOs and PPOs are healthy and well prepared to play starring roles in reform. The revenues in 1992 compared to 91 were up 12% and up 170% from 1988. HMO enrollment was up 15% from 91, 75% from 1988. So, HMOs and PPOs are poised and 'ready to go' in terms of health-care reform. By 1996, 40-70% of patients in most health-care markets will be capitated. That means they are capped or have a fixed cost per person. The tricky part is predicting how fast capitation will occur in your area because you should not 'shoot yourself in the foot' by developing many programs revolving around the capitation model when you are still being reimbursed by DRG and private insurance models. So, that is the tricky part.

There is no compromise reform plan now that we have had the elections. So, it is definite that there will be no government alliances. I believe that there will be a less aggressive phase-in period for any change that does occur. However, I think it is very unlikely that we will see any major change—at least in the next 2 years. The changes will occur at the local and state level and will involve managed care plus capitation plus competition. So, what we are seeing is a new set of incentives being developed. We have to unlock the creativity of physicians. Physicians still control 80% of the costs that are generated in hospitals, just because of the power of the pen. With such things as respiratory care protocols and other physician-assisting initiatives, we, as respiratory care practitioners, can have a role in reducing some of that cost, as well.

Utilization control is the essence of cost control. Under capitation, one wants to increase the number of capitated enrollees—to spread out the cost of the program over as many people as possible because there will be individuals who are going to require more than the average amount of care. So, what we are seeing is the transformation of the American health-care system. The fundamental structures of this system will be fully integrated and known as seamless care, or hospitals without walls. Also, it has been said that by the Year 2000, ambulatory care will generate 50% of hospital revenue.[1] So, if you expect during the next few years to continue to do the same things that you are doing now within the four walls of the hospital, you may be very disappointed.

Trends in Medicine

In addition to these trends in health care, there are some trends in medicine itself that I think are important to note. A British magazine called *The Economist* published the results of a survey on the future of medicine, in March 1994,[7] peering into the Year 2010. One of the widely held perceptions was that health care is going to become part of the 'information highway.' Information is an integral part of our society, and if we are not looped into it, as health-

care practitioners, we will be left behind. That means that we need to develop clinical databases; we need to develop electronic charting mechanisms—anything that will tie information to all of the integrated parts of our system is going to become important.

Surgery will be less intrusive, less painful, and safer. We already have some surgical techniques worked out for ablation surgery that can be done with ultrasound waves without even penetrating the skin. We can do some computer-assisted surgeries, and there is a pilot project underway with a device called the Robo-Doc.[7] The device is used during orthopedic surgery to drill a hole—a very fine, precise hole— into the femur to facilitate the placement of an artificial hip. It has been found that the Robo-Doc can actually drill the hole much more consistently and more precisely than a human being can. So, technology interacts with the human aspects of medical care.

Biotechnology will change drugs from palliatives to full scale cures. We can already produce insulin genetically—clone the gene, put it in bacteria, and allow the bacteria to produce insulin.

One half of health-care expenditures, by the Year 2000, will be taken up by the 65 and older population,[7] so we must manage end-of-life care. My Medical Director, a pulmonologist, is very interested in this. He has shown me statistics about the percentage of health-care dollars expended in the last 6 months of life and has pointed out how we need to have more advanced directives and how we need to manage that last 6 months of care. I told him that I agreed with him totally, but if I get sick and he is caring for me, I really want him to be accurate when he identifies my last 6 months of life.

Genetic engineering will assist in the elimination of some diseases—perhaps, cystic fibrosis is a candidate for the application of this technology. In 1993, the first map of the human genome was developed—a step toward chromosome manipulation and the beginning of some very exciting aspects of genetic engineering that will affect the health-care industry.

Demonstrating Value and Creating Opportunity

Avoiding the 'Sillies'

So, we are respiratory care practitioners, and we need to know about health-care reform and how to demonstrate value and create opportunity. Sometimes we are our own worst enemy. People sometimes behave stupidly. Respiratory care practitioners are not different. Even Forrest Gump was smart enough to know that stupid is as stupid does. There are no really stupid people, but sometimes we behave inappropriately and not in our own best interest. This is a hard thing to fight because we are human beings, and we deal with other human beings. It is hard not to act silly sometimes when people are asking you silly questions and doing silly things around you. It is my contention that life would be easier if silly people wore a sign—then we would not have to depend on them. We could easily identify the silly people and realize that they were not going to act in their own best interest. They may ask silly questions. For example, you have pulled to the side of the road because of a flat tire. You have taken the jack and the spare from the trunk of the car when somebody comes by and says, "Do you have a flat tire?" I have a strong compulsion to say, "No, actually I was driving down the road, and the other three just swelled up on me!" Or perhaps you are moving—carrying boxes and furniture out to the truck. A neighbor walks by and says, "Are you moving?" You want to say, "No, actually every few weeks we box up all our stuff just to see how many boxes it will take." Parents are the worst at this. We as parents say silly things all the time. My parents said silly things to me. One time I was misbehaving a little bit. My dad looked at me, pointed his finger, and said, "You go to your room until you learn how to act." So, I was up there for a while, and I came down, and I said, "Dad, I think I know how to act now." He says, "Well good. It's about time." I looked at him and I said, in a dramatic Shakespearean voice "To be or not to be ..." He said , "You watch your mouth." And, I replied with a bit of adolescent insolence "I can't watch my mouth! You watch my mouth, and I'll watch your mouth!" Of course, he responded "Go to your room till you know how to act!" Now what did we accomplish with all that silliness?

Respiratory care practitioners may say, "I don't want to learn to do home care. It's more work for me." I just want to say, "Here's your 'I'm Silly' sign! Wear it. We don't want to have to depend on you." You must be smart. Strangely enough, this is the past that someone in the future is longing to go back to, and we need to keep that in mind. These are the good old days. They have always been the good old days, but we have to be futuristic. Panic is unnecessary at this point and is always counterproductive; however, complacency is deadly. There are always going to be sick people, so why worry about what we do in health care, right? Well, look at all the changes that have occurred in just bronchodilator care in the last year—the new drugs that have developed, the longer duration of action. What happens when we perfect a drug that has a 24-hour or 48-hour duration of action for bronchodilation? How many small-volume nebulizer treatments will we do in hospitals then? How many FTEs (full-time equivalents) are associated with that work right now? Do we need to be thinking about that? I think so! In Europe, there is a drug called Combi-Vent, a combination of ipratropium bromide and albuterol, that seems to be working quite well.[8] It has not been approved

for use in the U.S., yet. But you say, "Kevin, the only worry is about these entry-level people who are providing only bronchodilator care. I work in a pulmonary diagnostics lab with highly sophisticated equipment. That takes a lot of education—there's always going to be room for me, right?" And I say, "Well, you may be right, but, what if they come up with the one-breath-does-it-all pulmonary function study that measures lung volumes and lung capacities?" That is very possible with the developing technology. Computerized tomography (CT) is already better than conventional methods for quantification of air-trapping in COPD. The reason that it is not used routinely is because it is too costly and generates considerable additional radiation exposure. Remember when the simplest hand-held calculator cost $150? What happens if technology lowers the cost of CT, and we can deal with the radiation exposure by shortening the length of the procedure? We may do more of that type of work than pulmonary function studies. Genetic testing may be more important than some of the diagnostic studies that we do. I do not know if any of these things will come to pass. They may not. But I do know that we as practitioners, whatever our specialty, need to be thinking about what is happening now and what could happen in the future, and how we are to become a part of the future?

Developing Skills

I have some advice for managers, and I have advice for staff-level practitioners. What managers must do is to build a skills plan. Now, with all of the background that I have mentioned already, what are some important things that we need to know? Managed care, for one. If you do not know what managed care is or you are not familiar with various insurance products, pricing, and integration, you need to be doing some reading. Choose a mentor—someone to help you. Get to know people in the insurance industry. Communication is always important. I think that can be applied to any field, to any level of employee. We must know about computer options and application. They are a part of our existence now, and they will be a greater part of our existence in the future. Hospital finance is certainly an area that you must be skilled in to be one of those clinical executives. I think that you who have clinical skills in addition to executive and financial skills have an advantage because when somebody says, "We need to buy a $200,000 echo machine," or "We need to buy a $50,000 pulmonary function system," you know exactly what they are talking about, what the equipment will be used for, and whether it is appropriate. So, build that skills plan.

Do something concrete in the eyes of others. Auto-pilot is deadly; retired on the job is deadly. You have to get out there and volunteer. Volunteer for programs that can provide you with some successes because success and effective interaction with other people are why you will be invited back to the table the next time. The most frightening aspect of change is not being invited to the party—to plan its implementation. That is critical to our success.

Don't forget to say, "Thank you" to your employees, to your bosses, to your cross-functional team members. Being polite, as well as knowledgeable and helpful, is important in this day and age.

Manage your Rolodex. Is the number of your contacts growing? Do you have contacts outside the respiratory care department? Do you know people outside the hospital? If not, you are probably too focused in your approach to your job. You need to know individuals throughout the continuum of health care. One of the ways that this can be done is through the AARC subspecialty and expert lists that have been developed—lists of people who are experts in a variety of fields and good people to get to know. Set wild goals. Think tenfold, not 10%. What impossible thing, if made possible, would improve your area? (Perhaps the person who laughs about that is thinking of his boss.) Remember that 3-M Post-It notes were developed as a mistake when 3-M was trying to develop a strong adhesive. Ivory Liquid was developed as a mistake when Proctor & Gamble was making bar soap. So, think wild! Think about something that is not possible, but think globally. The Swiss watchmaking industry made a major mistake back in the 60s. They decided that the technology of quartz crystal watches was never going to catch on—that no one would ever want to wear a quartz watch. Well, the Japanese thought that maybe people would—and they took over a major portion of the watchmaking industry. So, we are not in the respiratory care business—we are in the health-care business. And, our interest and influence extend across the entire continuum of care.

We need to have fun, and we need to dream a little. You need to remember why you got into this business in the first place. It was most likely due to things such as the rewarding experience of weaning someone off a ventilator—hearing them talk to you for the first time. I was trying to wean a person from the ventilator one time, and she was trying to communicate to me by writing notes. This is an example of communication being important. She had myasthenia gravis, a neuromuscular disease that makes you a little weak anyway. She was trying to write notes to me and was becoming more and more frustrated. Finally, on about the second or third day of this, she sat up straight in bed, mustered all the strength that she could, put the pen to the paper, and wrote, "I'm left handed." So, I removed the restraints from her left hand, and she wrote me some very clear notes.

You have to release the creative genius in people, but you say, "Well, I'm just one little cog in the wheel here. How can I provide any kind of genius to my organiza-

tion?" A hospital in Ohio released the creative genius in its people. Each and every employee was challenged to come up with an idea to make the job better and to interact with patients more appropriately. A maid who had worked in housekeeping for a number of years and had cleaned thousands and thousands of rooms was cleaning yet another room. As she went through that room she thought to herself, "All I do is clean rooms. What can I possibly do to improve the image of health care at our facility?" She thought about how she liked flowers—how she liked the way they looked and smelled and how sometimes they made her happier when things were not going well. She suggested that the hospital place one single rose on the bed pillow of every new admission. It cost them some money, but it was a tremendous success. All people could talk about was the rose on their pillow. They forgot that they had to wait an hour and a half in x-ray and that their oatmeal was cold. All they thought about was the rose. I am not suggesting that we cover up poor care by putting out showy things, but this story points out that releasing the creative genius in people at all levels of the organization can be a very powerful tool. We need to conduct a failures audit. It is OK to fail. If you don't fail, you are probably not trying hard enough or pushing yourself hard enough. You need to be a role model. This is extremely important. You need to be able to communicate, to be what you want your employees to be, to have a level of confidence, and to not panic.

Reacting to Adversity

If you are running around like Chicken Little, and the sky's falling, and you are worried about this job and that job and what we are going to do, that is not the image that will inspire confidence. If you don't represent your staff effectively, you are doing them a big disservice. You must set a plan, you must be positive, you must volunteer, and you must be a change agent.

The reason that being a role model and being a representative is so important is because many restructuring activities are already happening—and I am here to tell you that if the restructuring decision has been made in your hospital, it is too late to influence it. Your position must be that decision is great. You should try to support it 100%, and try to find out how you and the members of your department fit into that plan. Trying to tear that plan down will do nothing more than tell the people who have made the decision that you think they did not know what they were doing—that they made a bad decision. That is not the way that you want to represent your department. However, if a restructuring decision has not been made, you must position yourself to be a part of the decision making. Do anything that you can to get to the table on these restructuring processes. If someone can do something cheaper, and with the same quality, they should do it. That is why I do not think we should be paranoid about restructuring options.

Decentralization and Cross-Training

All ancillary services are not the same. When people talk to me about pharmacy and x-ray and lab and respiratory therapy all in the same breath and say, "Should we decentralize ancillaries?" My comment is, "Respiratory care has been decentralized for years and years. We may meet in the same central location. We may eat lunch together occasionally. We may store the equipment in the same place, but we spread out to all parts of the building every single day. I still believe in the decentralized approach to health-care restructuring, in that you decentralize resources or skill mixes or values as you need to. But, some institutions have spent a lot of money on total decentralization, and what they have lost is a lot of time spent in training and retraining, which can be very costly. Also, I believe that they have cross-trained at an inappropriate level. They have cross-trained at the busywork level. They have taken trained respiratory care practitioners, put them on a specialty unit floor, and said, "We only need a half FTE of your time today to do respiratory care; so, we are going to cross-train you to pass food trays, empty the garbage, and draw bloods and do these important things to people." And they are important things, but I think, to be cost-effective in hospitals, we need to cross-train at an equal or higher level, and so my whole philosophy at my hospital is that I will give you that half FTE that you need on that specialty floor. He or she will be a part of the team, will participate in all the conferences, will be a real team player, but when you no longer need that practitioner, I want him to assist with a bronchoscopy or go to the ER to do an intubation or go to the ICU. That is effective, decentralized cross-utilization.

Utilization Control

Another point to consider is that utilization control is the major cost-reduction strategy in hospitals today. We can talk about all the money that we can save with restructuring and all the money that we can save with cross-training, but the real opportunity to save comes with doing less for people who do not need it and being able to do that through various demonstration projects.

Restructuring must deal with the entire continuum of care. That is the other problem with some of this point-of-care testing. The focus is on inpatients, but we have an entire continuum of care to deal with.

Cheaper labor providing overutilized care is not cost-effective. If you have $6-an-hour employees providing

100% of the ordered care, but 30% of that care is unnecessary, that is not cost-effective. That is where some of the initiatives of respiratory care protocols come into play. As therapists, we need to demonstrate our value by saying, "I can participate in a care plan that will provide good quality and reduce cost."[9,10]

What should respiratory care practitioners do, then? We must build a skills plan, and that skills plan needs to be built around preventive care, teaching, and communication. Genetics might be a good thing to know about, with all the changes in gene therapy that are coming about. We need to be caregivers. We should not become patient-care evaluators only. That is too costly, and hospitals and health-care systems will not be able to provide for that. We need to be cost-effective and computer literate. We need to be extremely good patient evaluators. We have to demonstrate our ability to evaluate the patient, establish a care plan, and administer that care plan.

In Summary

We should embrace respiratory care protocols. We have had a system in our hospital for more than two years;[11] it has been very successful. We have approximately 60-70% of all of our therapy now ordered by a true protocol process. Some people have been dragged kicking and screaming through this process, including a number of respiratory care practitioners. It is more work. It is harder. Yes, it takes more time and more work to be a professional, but a professional is what you want to be. Anybody can go around and stick those nebulizers in people's mouths, but not everyone has the skill to determine which patients do not need that nebulizer or which may need a different drug or a different therapy. We must demonstrate through projects our ability to have an impact on the delivery of unnecessary and inappropriate care, and we must have physician support for what we are doing. These elements are essential to our survival.

When we embrace appropriate and effective technology, we demonstrate value. If we show—through improved weaning technology—that we can decrease length of stay by decreasing the time that people are on ventilators, we demonstrate value. If we function as effective bronchoscopy assistants who help to treat people and get them out of the hospital or avoid hospitalization entirely, we demonstrate value. So, we must embrace technology.

We need to function across the entire continuum of care to demonstrate value. We need to start managing health instead of managing illness. As the financial incentives to do that develop, we need to have the skills and the education to be able to 'pull that off.' I challenge all of you to develop those skills now.

We need to be change agents to demonstrate value. We need to eliminate personnel who project a poor respiratory care practitioner image and those who have chosen to wear a silly sign. We earn respect through image and what we do and how helpful we are. Sometimes we resist the very change that will secure our future. What do respiratory care practitioners do? It is scary to ask that question in hospitals, even today, because people sit at executive tables today and make decisions, sometimes without input from respiratory care managers. They may ask, "What do respiratory care practitioners do?" "Well, those are the people who put nebulizers in people's mouths, do incentive spirometry, and tell people to take a deep breath." "Oh, well OK, we can do that with a lower level of employee, so let's go ahead and make this change, decentralize, bring some consultants in, and we're done." That is extremely dangerous, but it is the image that many of us have projected as respiratory care practitioners. Do you want an incentive spirometry image or do you want a respiratory care protocol image? That is the question that I ask of you, and I suspect that unless you want the respiratory care protocol image, your future is not necessarily a bright one.

If we demonstrate value, we will create opportunity. I have a formula for value and it is

$$\text{flexibility} = \text{value}.$$

There are other formulas for value. One is

$$\text{quality} \div \text{cost} = \text{value}.$$

If you lower cost (the denominator), even when quality remains the same, you have improved value. At our facility as an offshoot study of our protocol process, we looked at the cost of caring for each COPD patient in our facility last year. We found that it cost $400 more to have resident-physician coverage on a case than simply to have an attending physician. The next thing that we hope to do, now that we have those numbers, is to select a group of patients for whom the respiratory care practitioner will be the case manager and look at the overall appropriateness of the care that they are receiving. Using this demonstration project, we hope to show that we are as much as $400 less costly than the attending physician. With those data and those demonstrations, we can create our own opportunities. That is what we need to do in our profession. I challenge you to think about that, and develop projects that will allow you to prove that every day.

I end with some quotes:

> Of course it's hard. If it wasn't hard, everyone would be doing it. The fact that it's hard is what makes it good.
>
> *Tom Hanks, actor*
> in the film *A League of Their Own*

This was Tom Hanks speaking about women professional baseball players. I think this can be applied to the respiratory care profession, as well. Of course it is hard, but we have to do it. It takes more effort to be a professional.

> Decide what you want to do, and don't give up until you do it.
>
> *Deke Slaton, astronaut*
> in the PBS production *Moon Shot*

Because of an inner ear disorder, Deke Slaton, one of the original Apollo astronauts, worked for approximately 12 years before he finally had a chance to fly a space mission. He sought medical care, hung in there, stayed involved, supported the system in every single way that he could, and finally, after all those years of hard work, flew the first Apollo mission that rendezvoused in space with the Russian cosmonauts.

> You must become the change you want to see in your profession.
>
> *Kevin Shrake, optimist*

People can accomplish difficult things, and, not everyone who perseveres prevails. However, those who do not persevere cannot prevail.

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Second International Cochrane Colloquium—Official Annual Meeting of the Cochrane Collaboration: A Conference Report

Background

The Cochrane Collaboration (CC) is an international group of scientists who collaborate to "prepare, maintain, and disseminate systematic reviews of the effects of health care." The Second Annual Cochrane Collaboration Colloquium convened in Hamilton, Ontario, on October 1-4, 1994. I became aware of the Collaboration through contacts generated during my research on meta-analysis (MTA),[1] which is a quantitative, systematic review. I attended the Colloquium to learn more about MTA and because I had become interested in contributing to the efforts of the CC. The purpose of this report is to make the respiratory care community aware of the CC, its activities, and the scope and significance of its contributions to health-care science on a global scale.

The CC got its name from a British physician, Archie Cochrane, who wrote a book in 1972 titled, Effectiveness and Efficiency: Random Reflections on Health Services.[2] Based on the proposition that health-care resources would always be limited, he advocated the application of reliable information to reach health-care policy decisions. In the belief that randomized clinical trials (RCTs) provide the most reliable information, Cochrane asserted that findings from RCTs, as a reference standard, ought to provide the basis for such decisions.

However, Dr Cochrane also knew that consumers of the research (ie, policymakers, practitioners, and patients) could not be expected to digest the enormous amount of information available from dispersed and disparate individual studies on health-care interventions. Therefore, Cochrane emphasized the need for systematic reviews of primary studies for the consumption of policymakers, practitioners, and patients. These reviews function to summarize research findings for health-care decision makers, ie, the reviews link the researcher to those who use research findings. The CC was organized to accept the charge to provide systematic reviews of topics based on studies that meet global standards for conducting and reporting them.

Members of the CC are organized into special-interests groups, called Collaborative Review Groups (CRGs). Each CRG reviews the scientific literature within a particular domain of interest to clarify outcomes or effects of therapeutic interventions. Three groups of particular interest to the respiratory care community are (1) Acute Respiratory Infection and Otitis Media, (2) COPD and Asthma, and (3) Neonatal CRGs. Although the members of a CRG are likely to be scattered across the globe, communications are facilitated by using electronic media instead of paper whenever possible and feasible. The CC uses Internet extensively. The addresses and telephone numbers of Cochrane Centers and CRGs are in the Appendix.

Overview of the Colloquium

The attendees were an interesting mix, including contingencies from Canada, the United Kingdom, the Netherlands, the USA, Japan, Australia, and Italy. Although many attendees were collaborators, there were representatives from the Canadian Health Department and our own Centers for Disease Control and Prevention. The presenters were like a "Who's Who" in MTA research. It was a friendly group, gathered to pursue a common interest—furthering the science and practice of systematic reviewing.

Workshops were the order of the day for Saturday and for Sunday morning. Selecting from the offerings was as difficult a choice for me as is making selections from our AARC Convention program. During each time frame, there were at least three interesting workshops in session.

Saturday, October 1

I attended the workshop, "Training for Hand-Search Trainers," that was led by Dr Kay Dickerson of the Baltimore Cochrane Center. Although this may not sound like a very interesting topic, I had pre-registered for this session because hand-searching is vital to constructing systematic reviews by Cochrane standards. As mentioned earlier, the RCT is the reference standard for measuring treatment outcomes. So, these are sought as the substance for reviews.

An important problem with locating RCTs in our current electronic databases is that many of them were improperly indexed when they were initially entered. Because an electronic search will not capture *all* trials, which is the rule for systematic reviews, the biomedical literature must be hand-searched, in some journals as far back as the 1940s, to identify RCTs.

In cooperation with the National Library of Medicine (NLM), the Cochrane Collaboration currently is developing an International Register of RCTs of Health Care. This will require hand-searching of all the biomedical literature to identify RCTs and Controlled Clinical Trials (CCTs). The difference between an RCT and a CCT is that an RCT clearly and explicitly reports randomization of subjects to experimental conditions, whereas, a CCT report does not. Therefore, a CCT is a questionable or "quasi-RCT." The Register that results from this combined effort is a public resource that expedites identification of trials for reviewers.

During the Saturday afternoon workshop titled, "Special Issues and Pitfalls in Meta-Analysis." Prominent meta-analysts (such as Drs Salim Yusuf, David Sackett, and Thomas Chalmers) presented and discussed examples of meta-analyses. The discussions focused on methodologic issues, particularly statistics. The initial discussion focused on disparities in findings between MTAs and large RCTs. Because RCTs are reference standards, disparities in findings between the two methods cast doubts on the validity of MTA. However, applying a statistical technique called meta-regression resolved the disparity in at least one instance. The presenters examined bias in conducting and interpreting MTAs and RCTs. The main points of the workshop were:

- statistical procedures for MTA continue to evolve—the fixed effects model for combining data appears to be on its way out, and subgroup analysis requires meta-regression;
- meta-analysts can bias their studies by their selection of research questions and outcomes to evaluate;
- bias in MTAs can be reduced by conducting them prospectively;
- findings from MTAs, especially those from subgroup analyses, should be interpreted with caution.

Sunday, October 2

During the Sunday morning workshop "Seeing the Woods for the Trees—Disentangling Complex Interventions and Multiple Outcomes." The points were made that although a simple intervention might be a drug or some other concrete, discrete variable, complex interventions often have behavioral aspects, such as educational ones, and that complex interventions tend to be multifaceted, therapist dependent, and context heavy. Those presented for the workshop included clinical practice guidelines, stroke-care units, and counseling for alcohol abuse. Multiple outcomes included variables related to physicians' management practices and various patient outcomes.

The presenters' key points centered on the need for reviewers to analyze study contexts (that is, the who, what, when, where, and why, of primary studies). The capability to do this rests on the primary investigators because, as a prerequisite, they must report such information. In recognition of the confounding nature of complex interventions, the participants recommended formation of a group to examine methodologies for their analysis.

On Sunday afternoon, I inadvertently 'crashed' a meeting of the Steering Committee of the Acute Respiratory Infection CRG. My presence as an observer was welcomed. It would be hard to overstate the cooperativeness among CC members. A motto mentioned during this meeting was "steal shamelessly, and share seamlessly"—a motto that was admittedly stolen, shamelessly, from another research group. Introductions by CRG members included specific topics of interest for systematic reviews, which included otitis media, pneumonia, vaccines, and bronchiolitis.

The Committee recommended that the CRG consult with organizations such as the American Academy of Pediatrics and the World Health Organization to prioritize topics for MTA. The general thrust for doing the MTAs is to impact public policies on pediatric care, possibly by using the MTAs to generate clinical practice guidelines.

The Committee addressed immediate goals of the CRG, which included hand-searching for RCTs and CCTs on all pediatric issues, including acute respiratory infections. Funding, of course, was a major issue. Although Cochrane Collaborators are volunteers, funding is needed for administrative structures and to support communications, travel, and other various functions of the Collaboration. To avoid the appearance of conflict of interest, the CC prefers support from charitable foundations, rather than commercial sources.

Monday, October 3

Monday began with an hour of 'walk-around' to view posters, followed by the presentations. There was abundant interaction between presenters and the audience. Disagreements were aired in good-humored, collegial fashion. The purposes and salient findings described by selected presentations were as follows.

- Using casts of dice, a study of chance effects on results of MTA demonstrated that random error can cause erroneous treatment effects to emerge.[3]
- Using similar search terms to locate RCTs on manual medicine, researchers tested the cost-efficiency of

CHIROLARS (chiropractic literature), EMBASE, MEDLINE, and CINAHL databases. MEDLINE was the most efficient, followed by EMBASE, which is expensive, and CHIROLARS. CINAHL failed to contribute beyond the other databases.[4]

- A study of 36 MTAs tested the restriction of journal source language to English, finding that at least one MTA would produce different results if non-English sources were included.[5]
- A study of 250 trials from 33 MTAs analyzed the association between allocation concealment (blinding) and treatment effects, finding inadequate or unclear concealment associated with larger treatment effects.[6]
- To compare the results of MTAs of smaller studies with those of large studies, the results of over 40 MTAs were analyzed using the random-effects model. The between-group results were comparable, but a special statistical technique, meta-regression, is needed to account for contextual factors.[7]
- To measure how audit and feedback to health-care providers affect clinical practices, 27 primary studies were systematically reviewed. Moderate effects of audit and feedback on outcomes were found, such as diagnostic-test ordering, prescribing, and preventative measures.[8]
- To assess the association between control rates and found treatment effects, over 50 MTAs were analyzed using special statistics, finding that discrepant findings in primary studies may be due to differences in control rates.[9]
- To test the effect of nursing support on rate of epidural anesthesia, 20 hospitals were randomly allocated to experimental and control groups. The experimental group used specially trained nurses to support laboring patients. No differences were found between the groups.[10]

Conclusion

The Cochrane Colloquium was marked by impressive people, presentations, discussions, and cooperation. Although MTA is a relatively new research method, its use continues to accelerate, expand, and change. Cochrane collaborators, who are dedicated to MTA, also are serious critics of the method. A common thread throughout the presentations favored conservative interpretation of MTA findings. Because of the revisions arising from their criticisms, MTA methods evolve and improve. Statistical techniques seem to bear the brunt of the change.

Individuals from the respiratory care community can make significant contributions to the CC effort. The CC actively seeks people to engage in research activities at many levels. At the beginner's level, the CC needs people to hand-search and identify RCTs to include in the database. This would be a worthwhile project for students to undertake. I have volunteered to search 10 years of a journal myself. The *American Review of Respiratory Disease* (now the *American Journal of Respiratory and Critical Care Medicine*) is one journal that has not been searched at all. Those interested in organizing or doing hand-searching should contact the Baltimore Cochrane Center (see Appendix). Furthermore, the CC needs people to become involved as reviewers, especially those who can search and review non-English journals. Prospective reviewers should contact one of the Cochrane Centers or the CRG they choose to serve. The Centers provide instructional materials and reviewing software, free-of-charge, on request. Many of these can be 'downloaded' from Internet.

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APPENDIX

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RETROSPECTROSCOPE REDUX:

The WITCH Doctor, The WHICH Doctor, and the WISH Doctor

JULIUS H. COMROE, JR.

The practice of medicine began long before recorded history, and professional historians have divided its story into scores of eras. Here, I am writing a bit about only three of these eras; that of the *Witch* doctor, that of the *Which* doctor, and that of the *Wish* doctor. The last of these probably came first and has ever since enjoyed an almost continuous practice.

The WITCH Doctor

He wasn't all bad. First of all, in common with all doctors in all eras, he had nature working for him. Except in devastating epidemics, most individuals do recover from a single episode of an acute illness, with or without the presence of any type of doctor. And nature, acting through what we now call the body's defense mechanisms, or its inherited or acquired resistance to disease, has probably increased its curative powers over the centuries by the process of survival of the fittest.

Second, the *Witch* doctor had very effective psychotherapy working for him in the form of his incantations, gyrations, ritual dances, and masks—and both doctor and patient knew that these had the power to combat or actually drive away evil demons that caused disease—or "low-level wellness."

Third, over the centuries, *Witch* doctors put together a little pharmacopeia of their own—from leaves, roots, barks, nuts, and seeds, or from choice morsels of animal origin: "eye of newt, toe of frog, wool of bat, tongue of dog, adder's fork, blindworm's sting, lizard's leg, howlet's wing" (to quote Shakespeare), plus a pinch of dung and a dash of urine. Occasionally, a witch doctor hit the jackpot with one of these and had a specific cure. But whatever he dispensed did something positive that made an impression on his patient, and the more bitter or repulsive the taste (never concealed by a coating or gelatin capsule), the more effective the medicine.

Fourth, the *Witch* doctor had the advantage that he could spend full time practicing and improving his art. He didn't need FDA approval for a new or modified dance, chant, incantation, or concoction. He didn't have to fill out Medicare or Medicaid forms. He didn't have to know *how* his cures worked (when they did) or whether they harmed when they didn't work. He didn't have to determine the correctness of his diagnosis by performing laboratory studies or autopsy examinations. And his status did not depend on election to the Society for Clinical Investigation or publishing in its journal.

The *Witch* doctor, however, gradually lost ground to more learned men in Egypt, Greece, Rome, and elsewhere on the continent of Europe—men who called themselves physicians. They had more specific remedies, eg, opium from the poppy plant, quinine from Peruvian bark, colchicine from the meadow saffron, and digitalis from the foxglove. They knew not how, but opium relieved pain, quinine cured malaria (a disease "caused by *mala aria* or bad air"), colchicine helped patients with gout (although uric acid had not yet been discovered), and digitalis rid many patients of abnormal collections of water. Early on, physicians were permitted (and expected) to do both medicine and surgery; surgery at first included lightning-fast operations (30 to 60 seconds long) such as "cutting for stone," amputation of a limb, and trepanation of the skull. Later, after they happened upon ether and nitrous oxide, their surgical repertory became almost limitless, and some physicians became full-time surgeons (the beginning of specialization). Because early physicians attended patients at home, knew the whole family and their problems, and treated the poor free, they were so respected that people in the street tipped their hats to them. Though neither he nor his patients knew it, each physician was a "holistic" doctor.

The WHICH Doctor

Somewhere in the mid-1800s, there began great stirrings in medicine and an undreamed of explosion of knowledge. Lavoisier's 1776 chemical revolution really blossomed in the

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nineteenth century. Anatomists described the correct structure of the body, physiologists learned how the various structures worked and were regulated, pathologists classified diseases, and physicians learned to relate the patient's symptoms to specific disorders. Scientists disproved the theory of spontaneous generation, discovered bacteria and viruses, and proved that some of these caused specific diseases. New sciences of microbiology, virology, and immunology emerged. Physics provided medicine with x-rays and isotopes. Physiology spawned biochemistry, pharmacology, biophysics, and neurobiology. Anatomy got the electron microscope and became cell biology; biochemistry was out and molecular biology was in. DNA, genes, and genetics then went center stage. Laboratory medicine overpowered the medical history and physical examination. The upshot of all this was that no single physician could read all that he should, understand all that he read, or remember all that he understood.*

The result was inevitable. The conscientious general practitioner gave up his surgical and obstetrical practice and became an internist. But rapidly accumulating knowledge overwhelmed many internists, and they first gave up pediatric practice and later became cardiologists, or gastroenterologists, or chest physicians, or endocrinologists, or dermatologists, and so forth. Surgeons concentrated their efforts on surgical subspecialties, and pediatricians on pediatric subspecialties.

The doctor had now entered the era of the *Which* doctor. Where was the dividing line? Whereas previously a patient went to a physician to learn what was wrong with him, now the patient had *first* to divine what was wrong with him before he knew *Which* doctor to consult. Finding *Which* doctor wasn't too hard if you suddenly became deaf (otologist), couldn't urinate (urologist), or felt a baby moving about inside your uterus (obstetrician). But finding *Which* doctor became pretty difficult when you had a diagnostic problem (see *The New Yorker's* "Annals of Medicine") that required a modern-day Osler—simply because it's now (1979) impossible for a single physician to know all that he or she should about the subtle disorders of *every* system and organ of the body.

What to do? For some physicians the answer was group office practice; for others, it was diagnosis and treatment conducted on a hospitalized patient; for some medical societies, the answer was refresher courses for its members; for some governing bodies, the answer was yearly recertification of physicians. But as in practically every era of recorded history, up popped the *Wish* doctor again.

The WISH Doctor

There have always been medical quacks, charlatans, and fast-buck men selling snake oil with full knowledge that they were fleecing the public. The *Wish* doctors of whom I write are none of these; they are intelligent men and women—they may be Nobel laureates—and they believe in and practice what they preach. However, a *Wish* doctor does not need a degree or any formal education. He need not be a physician or a medical scientist; he need not even be remotely connected with biomedical science or with any branch of science. He or she can be an economist, sociologist, psychologist, writer, editor, foundation president, or a member of the Cabinet. The main theme uniting most *Wish* doctors is the idea that practically all disease can be prevented and super-health ("high-level wellness") can be maintained by simple measures, usually related to proper nutrition and "life style," and that this can and should be the full responsibility of each individual. A requirement for a top-notch *Wish* doctor is that he begin with a highly desirable, wholesome *wish* that he can magically convert first into a nondebatable *conviction* and then into an *incontrovertible fact.*

I remember two often-repeated phrases from my childhood days. The first was, "An apple a day keeps the doctor away." This could have been concocted by the advertising manager for the apple industry, but it might also have originated with a *Wish* doctor. If the latter, its sequence might well have been: *Wish:* "*I* like apples; I don't like doctors. I wish an apple a day would keep the doctor away." *Conversion to a conviction:* "An apple a day keeps the doctor away." *Possible extension of conviction:* "An apple a day keeps cancer away." Remember that even today the apple-a-day would require no FDA application, no controlled, double-blind randomized studies, no FDA approval, and no advertising; the *Wish* doctor would write a book (preferably one with one or two anecdotal case reports) and would hold it up during numerous television talk shows to advertise it for free.

The other phrase came from a French psychologist, Émile Coué, a strong advocate of autosuggestion; it was, "Every day, in every way, I'm getting better and better." Again, it required no scientific evidence that the patient was really getting better in every way, or even in *any* way; indeed, objective

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*The problem is well stated below:

"In modern times the constituent branches of medical science are so expanded, that they are not acquired by the physician in a life-time, and still less by a student during his pupilage. The same is true even of many individual branches. It is not, therefore, to be conceded that 'a scheme of scientific instruction should embrace the whole science, and no part should be omitted;' nor that 'a well-digested plan of lectures embraces all that is to be known and taught.' Medical science has at this day become so unwieldy, and contains so much that is unnecessary—at least to beginners—that the attempt to explain to students the whole, is likely to involve the result of their learning but little."

This quotation, from "Practical Views on Medical Education," submitted to the members of the American Medical Association by the Medical Faculty of Harvard University, July 10, 1850, suggests that the "*Which* doctor" era had its beginnings long before the knowledge explosion overwhelmed physicians of the twentieth century.[1]

proof of its value or lack of value would have been extremely hard to get.

I suppose that the dramatic life-saving advances in medicine and surgery in the 1940-1970 period made everyone forget about apple-ism and Coué-ism. Why have they reappeared, in a many-headed form, in the last few years? I believe there are many reasons:

(1) Scientists testifying before congressional appropriation committees have assured Congress that, with appropriate funding, medical advances would come along on a regular schedule. On June 18, 1965, the proposed Master Plan for a totally implantable artificial heart stated confidently that by Valentine's Day, February 14 (not February 15 or 16), 1970 (not 1971 or 1972), fully-tested artificial hearts would be available to replace badly diseased hearts in patients. And Congress resolved on July 15, 1970:[2] "That it is the sense of the Congress that the conquest of cancer is a national crusade to be accomplished by 1976 as an appropriate commemoration of the two hundredth anniversary of the independence of our country." 1970 and 1976 have come and gone, and there is neither a totally implantable artificial heart for patients with incurable heart disease, nor a cure for cancer. Yet during this period, the public has been told by the American Cancer Society, American Heart Association, and American Lung Association, who must point with pride to any research success, that lung cancer, emphysema, and much of cardiovascular disease could be *prevented* by eliminating certain chemical agents in the air we breathe or food we eat. Why bother with expensive treatment if cancer and heart disease are preventable?

(2) Major councils and boards of directors of institutes (including the National Institute of Health) and foundations have recently included more and more laymen among their members, to assist in making decisions on health matters. And the public in general, demanding "the right to know," now has available to it far more information on medicine, illness, and health than ever before. Unfortunately, many of these laymen have not at the same time been exposed to the meaning of scientific evidence and the objective ways available for judging information and deciding whether *a is* really better than *b*. One layman so exposed, Norman Cousins, has written:[3]

> The most important thing about science is the scientific method—a way of thinking systematically, a way of assembling evidence and appraising it, a way of conducting experiments so as to predict accurately what will happen under given circumstances, a way of ascertaining and recognizing one's own errors, a way of finding the fallacies in long-held ideas. Science itself is constantly changing, largely as the result of the scientific method.

(3) Ecologists, a group of great integrity and equally great energy, conviction, and militancy, have pointed with alarm to health hazards in the air we breathe (smoke, smog, chemical sprays, exhausts, radioactive emissions), the water we drink (chemical wastes), and the food we eat (additives, preservatives, residues of pesticides), and the FDA has found tests sensitive enough to find carcinogens under every stone. Again the logical emphasis has been on prevention, not diagnosis or treatment.

(4) Natural food faddists have insisted that "natural" is equated with "harmless" or even "super-wholesome." And if only nature's fertilizers are used for growing food, and all chemical sprays, additives, and preservatives are banned, health hazards will vanish and everyone will enjoy "high-level wellness." Yet as Martha Rhodes wrote:[4]

> It is naive to think that removing all additives, or purchasing only foods labeled *natural*, eliminates poisons from food. On the contrary, there are numerous natural poisons in food. For example, the potato has one hundred and fifty distinct chemicals among which the alkaloid solanine, oxalic acid, arsenic, tannins, and nitrate are toxic. Carrots, nutmeg, and pepper contain myristicin—a narcotic and psychomimetic. Arsenic is found in shrimp. Of the forty-two chemicals that contribute to the aroma of coffee, here are just a few: acetaldehyde, acetic acid, acetone, acetyl methyl carbinol, methyl mercaptan, ammonia, cresols, diacetyl, diethyl ketone, dimethyl sulfide, 2,3-dioxyacetophenone, esters, ethyl alcohol, eugenol, formic acid, furance, furfural, furfuryl acetate.

(5) The public wants miracle drugs but has developed ambivalent feelings about them. Sulfas and penicillin raised respect for drugs to an all-time high; reports of reactions to them and increased resistance of bacteria lowered their rating. Thalidomide led to more doubts about the use of drugs. Labeling sucaryl as a carcinogen caused additional concern, but on the other hand, naming saccharin as another led to an uprising against "Big Brother in Washington," and I suspect that labeling scotch and beer as carcinogenic will cause even more consternation and confusion. On the whole, however, events have made many patients become therapeutic (or at least drug) nihilists.

(6) Dentists, overjoyed by their first research success (that a specific mouth bacterium adheres to and attacks the teeth in the form of a plaque and that this bacterium feeds on sugar, among other foods) have mounted a nationwide campaign against sugar in every diet (even, I suppose, that of people with a complete set of dentures), completely ignoring solid evidence that an *additive* (fluoride) to the water supply is far more effective and practical in preventing dental caries than is removing sugar. Again, remember that a *Wish* doctor need not have scientific proof and FDA approval to *remove* something, eg, sugar, from the diet.

(7) The cost of hospital care has risen so steeply that any

call to concentrate on prevention of disease (rather than treating it once diagnosed) is a very appealing and legitimate one. And the most eloquent spokesman for the value of basic research, Dr Lewis Thomas, has confidently assured the public that prevention of disease is not only possible but, when achieved, will also turn out to be far cheaper than diagnosis and treatment once disease has occurred. What the *Wish* doctor ignores is that Dr Thomas has repeatedly expressed his view that the know-how to *prevent* disease will come from scientific understanding and attacking of the basic causes of disease, rather than from *Wish* doctoring.

(8) Medical research has made spectacular advances, but what the medical profession does *not* know is still at least as great as what it *does* know. Therefore, the patient for whom the *Which* doctor has no sure treatment might quite logically decide to try his luck with the *Wish* doctor who offers assurance, confidence, hope—all important placebo effects. Norman Cousins may be the only patient who will ever cure himself of an "incurable" collagen disease by the mysterious placebo effect of laughter, plus large doses of vitamin C, plus the will-to-live,[5] but today's patient is not restricted to following Cousins's regimen. As Cousins pointed out:[3]

> The individual who is looking for alternatives to traditional medical ideas has a wide choice of approaches with varying credentials—acupuncture, biofeedback, homeopathy, naturopathy, iridology, nutrition, vitamin therapy, chiropractice, meditation, yoga, astrology, numerology, pyramidology, graphology, psychic surgery, faith healing, apricot kernel therapy, Rolfing, touch encounters, self-massage, negative ionization, psychocalisthenics, etc.

In addition, there is Belloc and Breslow's recommendation that to live longer and be healthier, one need follow only simple rules of living:[6,7]

1. Eat three regular (moderate) meals a day.
2. Exercise moderately 2-3 times a week.
3. Obtain 7-8 hours of sound sleep each night.
4. Smoke no cigarettes.
5. Drink no alcohol or drink in moderation.
6. Eat breakfast every day; eat nothing between meals.
7. Don't be overweight.

Although some might be apprehensive and hesitant about enrolling in one or more of the alternatives that Cousins lists, Belloc and Breslow's plan seems reasonable enough. However, I confess that even in the tranquility of retirement, I seem to be unable to avoid stress and worry, and it's been decades since I've had 7-8 hours of unbroken sound sleep except before, during, and after a surgical operation. Further, my arthritis keeps me from regular exercise, and I always battle overweight.

What's Wrong with the WISH Doctor?

The obvious "what's wrong" is that the *Wish* doctor has neither the scientific training nor the inclination to make diagnoses of the specific diseases or disorders that respond far better to the modern medical care offered by the *Which* doctor than to the psychotherapy of the *Wish* doctor. It's also quite possible that your excellent *Which* doctor, although he's found no organic malfunction, may also be an excellent therapist and make recommendations that have a highly beneficial placebo effect. In brief, "primum non nocere." No diagnosis, or a wrong diagnosis, is a most effective way of harming a patient.

Another "what's wrong" is that no one knows which *Wish* plan is better than another because of lack of real knowledge. Even John Knowles, then president of the Rockefeller Foundation and a leading advocate of the individual's responsibility for his or her own health, on one page extolled the Belloc and Breslow plan, but on another wrote:[8]

> Attempts to prevent disease and improve and maintain health involve multifaceted strategies and expertise from many disciplines. *Fundamental to any and all such attempts is sufficient empirical knowledge,* ie, *knowledge gained through observation and trial-and-error experimentation* that *allows the advocate to convey his information with sufficient conviction* to change the behavior of his audience. Although a great deal of information is available, *the whole field of preventive medicine and health education needs far more fundamental research and long-term field experimentation....* The support of fundamental biomedical research has also flagged alarmingly in the past several years. *The basic biological mechanisms of most of the common diseases are still not well enough known to give clear direction to preventive measures* [emphasis added].

Knowles then added:

> So what do I do at the age of 50 years? I see my physician once a year for a general history and physical examination (including blood pressure, rectal-prostate exam), chest x-ray, hematocrit, stool test for blood, blood sugar and cholesterol tests, height and weight, immunizations when needed. My wife does the same, plus breast and pelvic examination. We both get regular moderate exercise, sleep eight hours a night, keep trim, and enjoy the odd cocktail. I will continue to have difficulty wrestling with seat belts.

Tragically, Knowles died this year, 3 years after he wrote the paragraphs above. He was 53 and died of cancer of the pancreas.

Lewis Thomas analyzed the Breslow report, and his comments are well worth repeating here:[9]

> It is hard to imagine any good reason for dying within 5 years from not eating a good breakfast, or any sort of breakfast.... The other explanation turns cause and effect around. Among the people in that group of 7,000 who answered that they don't eat breakfast, don't go off on picnics, are underweight, and can't sleep properly, there were surely some who were already ill when the questionnaire arrived. They didn't eat breakfast because they couldn't stand the sight of food. They had lost their appetites, were losing weight, didn't feel up to moving around much, and had trouble sleeping. They didn't play tennis, or go off on family picnics, because they didn't *feel* good. Some of these people probably had an undetected cancer, perhaps of the pancreas, others may have had hypertension or early kidney failure, or some other organic disease that the questionnaire had no way of picking up. The study did not ascertain the causes of death in the 371, but just a few deaths from such undiscerned disorders would have made a significant statistical impact. The author of the paper was careful to note these possible interpretations, although the point was not made strongly, and the general sense you have in reading it is that you can live on and on if only you will eat breakfast and play tennis.

A much less obvious "what's wrong" becomes very obvious with a moment's thought. Today's potent drugs—often life-saving—do have side effects that are unpleasant and sometimes dangerous to a sensitive individual. If manipulating one's "life-style" can have powerful beneficial effects on the mind, the heart, the gut, collagen synthesis, or cancer cells, such manipulations may also have harmful effects, of varying intensity in different individuals. And it could be that a regimen designed to lengthen life may actually shorten it.

And no one—I repeat, no one—could design, let alone complete a proper experiment to learn the effect of life-style on longevity. Consider the problem. He would have to select a huge group of young men and women—perfectly matched genetically, physically, and in their environment—randomly assign these young men and women to either a control group or to an experimental group, and then live long enough to follow them for 40, 50, or 60 years to complete the experiment and determine which group lived longer. Remember that each group must, of course, during the lifetime of those enrolled, have identical hazards to emotional and physical health—except for one experimental variable (eg, eat breakfast every day, or get 7-8 hours of sound sleep each night). The impossibility of completing such a study becomes obvious when one realizes that the scientists in charge of the experiment would long since have been dead (or lost interest in the project) and the entire world, including medicine, would have changed so remarkably as to make continuation of the controlled experiment laughable.

So where do we stand? Certainly we must adhere to the "primum non nocere" principle. The *Wish* doctor who espouses daily doses of 10 g of vitamin C no more knows the long-term (5 or 10 years) effects of his prescription than did Roentgen know that long-term exposure to x-rays would cause severe skin burns, cancer, and death. If the carcinogenic effect of x-rays had been discovered first, their diagnostic values would never have been noted, or, if noted, never used.

The *Wish* doctor does not really know that all natural foods are all good. Many of our beneficial drugs have indeed come from plants that grow wild in nature; digitalis is a good example. But digitalis is both a drug and, in slightly higher dose, a poison. Indeed, many of our most deadly poisons have come from naturally grown plants and trees: cyanide (in apricot pits and in Laetrile formed from them), strychnine, hemlock, and phalloidin (from *Amanita* mushrooms).

The organic-food *Wish* doctor does not really know that domesticated foods are safer when organically grown (ie, no synthetic, store-bought fertilizers added—only fresh manure). Recently, analyses of some organically grown foods show unsafe concentrations of cadmium, not present in chemical fertilizers.[10]

The *Wish* doctor who succeeds in stopping a patient from smoking may now have a patient struggling with the problem of obesity or increased stress. Statistically speaking, will the patient live longer with his smoking or with his obesity and stress? All three are considered risk factors for heart disease.

The *Wish* doctor who insists that his patient jog daily has no scientific evidence that the jogger will live longer; much published evidence indicates otherwise,[11] and many have suggested that joggers will have a higher incidence of arthritis (which I can assure you is not "high level wellness"). It is now certain that long-continued exercise does not prevent atherosclerosis: marathon runners do not live forever and may have clogged coronary arteries at autopsy.[12]

What are the long-term hazards in eating a high-fiber diet? Who knows? Not the *Wish* doctor. One *Wish* doctor insists that good health requires three regular meals a day,[7] but another, Nathan Pritikin of the Longevity Center, insists on eight small meals each day. Who's right? According to Elias,[13] 3,500 patients have each paid $4,600 to complete the Pritikin regimen; $16,100,000 must be a wish *really* come true.

Perhaps the greatest danger of all comes from the conviction and then fanaticism that one "life-style" is more conducive to health and long life than any other and that *everyone* now has a moral and legal obligation to conform to it. Am I a felon if I choose to enjoy life for 60 years rather than not enjoy it for 65 years? Some of my good friends say "yes" because I will develop more illnesses, see more doctors, and have more hospital admissions and this costs *them* more. How so? Their

argument is that my refusal to follow *their* "life-style" increases taxes and health insurance rates, and they'll be damned if they'll pay for my extra illnesses. To ease the concern of such callous, heartless, unfeeling individuals, I have made some simple calculations: If I die at 60 (instead of 75 or 80), I will never receive Medicare benefits or Social Security checks. My conforming friends will pay lower taxes and be far better off financially if I am a nonconformer, especially if I drop dead on the street and never require hospital care.

Concluding Remarks

I wrote in the opening paragraph that the *Wish* doctor probably came first, and has ever since enjoyed an almost continuous practice. Probably the largest group ever reported in a *Wish* doctor program were the 3,000,000 young people enrolled in the National Tuberculosis Association's "Modern Health Crusade" in the late 1910's.[14] Each signed a pledge that for at least 3 years, he would:

1. Have three meals of wholesome food a day. Chew thoroughly.
2. Exercise daily in the open air. Take ten *deep* breaths a day.
3. Get a long night's sleep and get up smiling.
4. Not smoke or use tobacco in any form.
5. Drink no tea, coffee, alcoholic drinks, or soft drinks containing injurious drugs.
6. Avoid fried foods, much meat, piecrust, cakes and sweets, and all impure candy.
7. Brush his teeth twice daily. Use dental floss. Bathe his whole body twice a week, and wash his ears and neck once a day.
8. Consult his dentist twice a year and his physician once a year.
9. Attend to toilet [empty his bowel] at the same time each day. Brush his shoes every morning. Keep his mind clean and cheerful.

Surely this Crusade was one of the great "Missed Opportunities" of all time. If only the National Tuberculosis Association had done a long-term controlled study of Crusaders versus Non-Crusaders, we would by now have learned, once and for all time: (1) How long do highly-motivated Crusaders stick to such pledges? 1 year? 2 years? 60 years? (2) Have all conscientious Crusaders lived well past normal life expectancy, and way past their Non-Crusader controls?

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Radiologic Abnormalities due to Penetrating Chest Trauma

Monika Hiltner BS CRCP

Case Summary

An 18-year-old man was shot in the back during an altercation. The gunshot wound was near the angle of the right scapula posteriorly, with no exit wound. On arrival in the emergency room, he was awake and alert with blood pressure 85/49 mm Hg [11.3/6.5 kPa] and heart rate 93. He was afebrile. His airway was patent and his breathing was tachypneic. Physical examination revealed good breath sounds on the left, but diminished throughout the right with rales in the right-upper lobe. A chest tube had been placed on the right side before arrival in the ER. The patient was moving his upper but not his lower extremities. The rest of the exam was unremarkable. The chest radiograph taken at admission is shown in Figure 1.

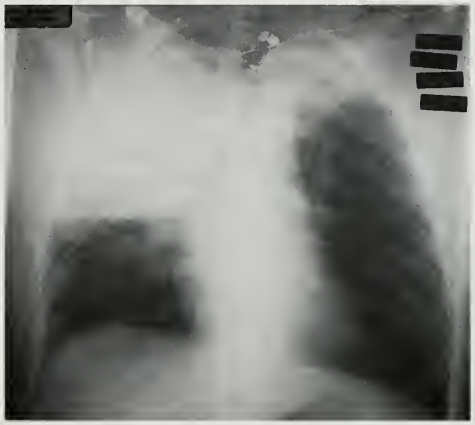

Fig. 1. Chest radiograph of a 18-year-old man on admission to the emergency room.

Ms Hiltner was an intern in Respiratory Care, Meritcare Medical Center, North Dakota State University, Fargo, North Dakota, when this work was done.

How would you answer these questions?

What radiographic abnormalities are present?_____

What physical assessments can be used to confirm the diagnosis suggested by the radiograph and physical examination?

Answers and Discussion on Next Page

Answers

Radiologic Abnormalities: There is severe consolidation of all of the right-upper lobe because of a pulmonary contusion and hematoma. In the left lung there is an irregular pulmonary contusion and hematoma involving a large portion of the upper lobe near the apex. The endotracheal tube is positioned high in the trachea and should be moved down about 2 cm. There is a chest tube on the right side, and a lateral radiograph would be helpful in determining its placement. It is most likely in the 5th or 6th intercostal space.

There are bullet and bone fragments scattered around the 2nd and 3rd thoracic vertebrae, with extrathoracic fragments also evident.

Physical Assessment: Clinical assessment of the patient's pulmonary status is performed using percussion, palpation, and auscultation. Areas of consolidation and contusion are dull to percussion, whereas areas of pneumothorax are hyperresonant. In patients who are able to vocalize, palpation reveals tactile fremitus that is increased near the consolidation and contusion and decreased near the pneumothorax. Subcutaneous emphysema may also be palpable in the presence of a pneumothorax. On auscultation over a consolidation or contusion, breath sounds are bronchial, but over a pneumothorax, breath sounds are diminished.[1]

Preliminary neurologic assessment is accomplished at the bedside using the correspondence of the spinal nerves to segmental fields of skin called dermatomes.[1,2] By pricking the patient with a pin at different levels on his body, the caregiver can estimate the level of spinal cord damage. The dermatome system is shown in Figure 2.[2]

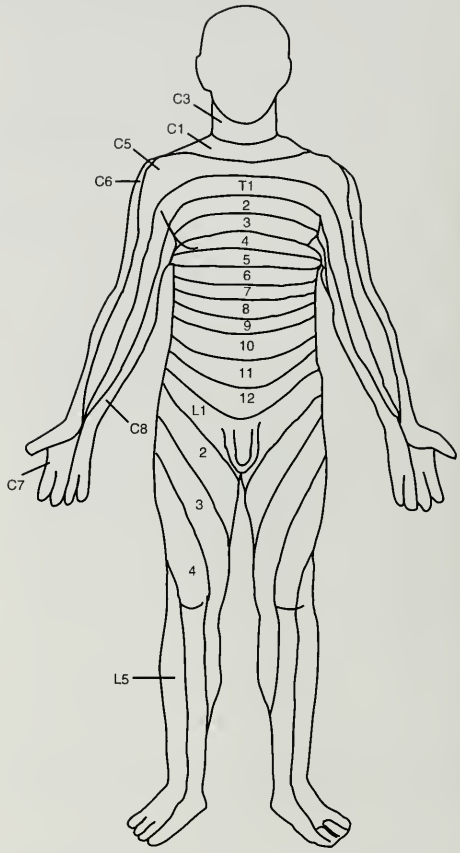

Fig. 2. The presence or absence of sensation in response to a skin prick at the various locations (dermatomes) exposes the level of spinal-cord injury. C = cervical, T = thoracic, L = lumbar.

Discussion

Trauma accounts for about 160,000 deaths each year in the United States. Of this number, thoracic trauma is the cause of 25%.[3-9]

Pathophysiology

Thoracic trauma may be divided into 2 types— penetrating and blunt. Blunt thoracic trauma is the result of a blow to the chest, damaging the heart and lungs without breaking the skin.[3-5] This occurs most often as a result of a motor vehicle accident, person-to-person encounters or contact as during sports, and falls. Penetrating thoracic trauma typically results from gunshots or assaults with sharp weapons such as knives or ice picks.[3-5]

The severity of penetrating chest wounds depends on many factors, including the location and depth of the penetration, the force with which the penetration was inflicted, and the object used to inflict it.[3,4] This man's wound was caused by a bullet. The severity of a bullet wound depends on the type of ammunition, the angle and distance from which it was fired, the type of firearm used, and the type of tissue that was penetrated.[3-6]

A thoracic gunshot wound may result in a number of pulmonary injuries. An open pneumothorax (sucking chest wound) requires immediate treatment because the loss of negative pleural pressure "sucks" air from the atmosphere through the wound into the pleural space. The ensuing compression of the lung causes severe respiratory distress. A tension pneumothorax may also lead to severe respiratory dis-

tress, and it could result in the compression of the heart—cardiac tamponade. Hypovolemic shock may result from bleeding and from the complications of cardiac tamponade, which include decreased cardiac output and hypotension.[3,4,9]

A pulmonary contusion, like the one seen in Figure 1, may result in respiratory failure and death if not properly treated. Hemorrhage into the interstitium and alveoli leads to decreased ventilation of the involved lung, which allows unoxygenated blood to reach the systemic circulation. Decreased compliance of the involved segments can lead to overdistention of the unaffected lung when mechanical ventilation is used.[3-7]

The Chest Radiograph

The thoracic injuries mentioned above can be detected radiographically. For example, pulmonary consolidation is fairly easy to recognize due to the solid white nature of the consolidated segment on the radiograph. In Figure 1, the upper right-heart border is obscured, but the diaphragm is easily seen. This tells us that the consolidation is in the right upper and middle lobes and not in the lower lobes. However, because the minor fissure of the right lung is visible, the consolidation is confined to the upper lobe. Small pneumothoraces may be difficult to see on a chest radiograph. One should be able to see the margin of slightly denser lung with darker pleural air between the lung and chest wall.[10] To show a pneumothorax more clearly, the radiograph may be taken on full expiration. This makes the lung more dense and the dark areas of pleural air easier to see. One could also use a lateral-decubitus radiograph to spot a pneumothorax because the air in the pleural space rises and collects between the lung and the chest wall.[10]

A pulmonary contusion can show one of two basic patterns on a radiograph. The pattern that is most commonly seen is a patchy, poorly defined area of increased parenchymal density. A lung that is severely contused may appear larger than the unaffected lung due to edema, and the affected lung's increased weight may push the diaphragm down. The less common pattern is one of linear and irregular infiltrates in the bronchioles.[11]

Spinal-Cord Injury

This patient sustained damage to his vertebral column and spinal cord, not uncommon with penetrating chest injuries. Gunshot wounds are the third leading cause of spinal cord injury in the United States, after automobile accidents and falls.[12] The bullet need not penetrate the spinal canal to cause a spinal-cord injury. The impact of the bullet on the vertebral column alone may cause swelling and damage to the spinal cord. In the case of this young man, however, several vertebrae were crushed and the spinal cord was penetrated, resulting in C-8 paraplegia. This patient's upper-body function continues to improve. His hospital stay was relatively uneventful. He was intubated for airway control and mechanically ventilated until his ventilatory capabilities improved. He received ICU care for 20 days and 36 days of rehabilitation and then was discharged to his mother's home. He continues in out-patient occupational therapy and vocational rehabilitation.

In Conclusion

Early recognition of acute pulmonary and neurologic impairment of a critically injured patient is imperative. However, equally important is early anticipation of the patient's long-term outcome because it is essential for directing treatment expectations during rehabilitation.

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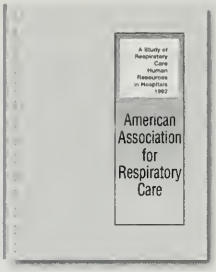
Readers are invited to submit manuscripts for this feature. Type double-spaced as follows: Brief case report (250 words or less), questions, answers, discussion (300 words or less), and references. Radiograph should be submitted as a full-size film copy and as a glossy photograph. Mail 2 copies of the manuscript and the radiograph and photograph to RESPIRATORY CARE JOURNAL, 11030 Ables Lane, Dallas TX 75229.

The AARC Human Resources Survey: A Study of Respiratory Care Human Resources in Hospitals



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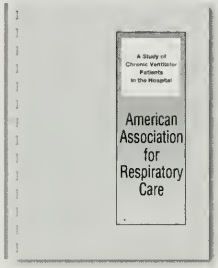

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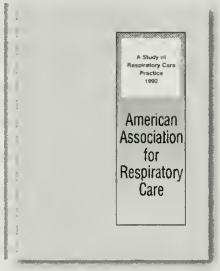

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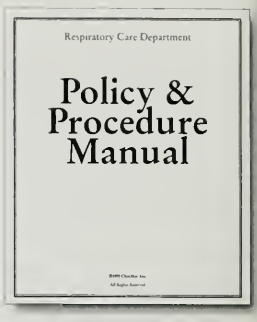

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Handbook of Sleep-Related Breathing Disorders, by JR Stradling MD. Hardcover, 296 pages, illustrated. New York: Oxford University Press, 1993. $60.00.

In the opening pages of the **Handbook of Sleep-Related Breathing Disorders**, JR Stradling writes, "This short book seeks to fill a gap in the literature on sleep-related breathing disorders." He continues, saying that many state-of-the-art texts deal with the physiology and pathophysiology of sleep disorders and many didactic accounts suggest "mandatory" diagnostic and therapeutic interventions for sleep-disordered breathing. Because few texts are available to guide clinicians in starting a sleep and breathing service, the purpose of this book, is to provide "a useful starting point to those interested in providing a [sleep and breathing] service for patients."

The book is not meant to provide a comprehensive review of sleep medicine, and Stradling focuses on 3 primary areas: (1) normal sleep and breathing and the pathophysiology and clinical presentations of obstructive sleep apnea; (2) diagnostic procedures including polysomnography and alternative diagnostic approaches; and (3) therapeutic approaches, epidemiology of sleep apnea, and differential diagnosis of sleepiness in adults.

We find that the information presented within the **Handbook of Sleep-Related Breathing Disorders** is concise and straightforward with ample references to pertinent literature. Chapter 2, "Normal Sleep and Breathing," provides detailed, yet simple, definitions and illustrations of the electroencephalographic criteria used to identify each stage of sleep) and explains that even though sleep produces restorative effects, the mechanisms of sleep are dynamic processes. The author explains how, during sleep, the body responds to stimuli much differently than during wakefulness—eg, carbon dioxide sensitivity is decreased (relative to wakefulness) and may propagate periods of ventilatory instability. Therefore, while one is asleep, any number of neural or biochemical imbalances may occur to intrude upon the rejuvenating effects of a healthful night's sleep.

Once the information necessary to develop the reader's awareness of the differences between normal and disturbed sleep has been presented, the **Handbook of Sleep-Related Breathing Disorders** addresses diagnostic strategies. The author proposes, "What really needs to be measured [with respect to obstructive sleep apnea] is (1) the root respiratory cause of the problem and (2) the most important consequence, ie, the sleep disruption that produces the symptom (sleepiness) that drives the requirement for treatment." He continues "Thus, the ideal monitor would measure respiratory regularity and effort and cross-correlate it with a measure of sleep continuity." Unlike U.S. physicians, Stradling does not advocate that full polysomnography be routinely performed as a diagnostic procedure for sleep apnea. He defends his position by stating that "As with all other areas of medicine, clinical outcome is the true gold standard, and the value of a test should be judged according to whether it identifies patients who will benefit from treatment."

Following a review of diagnostic strategies, the **Handbook of Sleep-Related Breathing Disorders** describes therapeutic options for sleep apnea. Here, theoretical foundations for two routine interventions for sleep apnea, uvulopalatopharyngoplasty and nasal continuous positive-airway pressure (CPAP), are discussed. Other topics, such as nocturnal noninvasive positive-pressure ventilation for central sleep apnea or hypoventilation syndromes, phrenic nerve pacing, and the management of "benign" snoring, are also addressed. Practical considerations, such as patient education and developing strategies to promote patient adherence to prescribed therapy, are emphasized.

Stradling believes that patient acceptance and adherence to nasal CPAP therapy are determined during the first and second nights of treatment. Therefore, he advocates that nasal CPAP be initiated during an overnight stay in the hospital, rather than in the patient's home. By initiating nasal CPAP in the hospital, staff members are available to provide support and to intervene if problems arise during the patient's first experience with treatment. By educating the patient about his disorder and ensuring that the first night of therapy is successful, Stradling envisions patients who are motivated to adhere to the prescribed therapeutic regimen.

In summary, we believe that the information contained in the **Handbook of Sleep-Related Breathing Disorders** provides the reader with the fundamentals of sleep disorders to incorporate into practice. Because sleep-disordered breathing has both physiologic and psychologic sequelae, this book provides a useful resource to a variety of professionals. Social workers and psychologists and respiratory care practitioners and nurses may develop a working knowledge of sleep-disordered breathing, enhancing their clinical assessment and decision-making skills .

In Europe, where this book originated, outpatient and home-based diagnostics are advocated, in part, because of practical constraints of medical practice in Europe (ie, allocation of available financial or technical resources). Consequently, the views presented by Stradling do not necessarily coincide with the practice of U.S. physicians. Nonetheless, we support Stradling's conclusion that there is "no one right way of doing a sleep study" and that "a good understanding of the problem is infinitely more important than insisting on having the full polysomnographic kit performed on all patients, as this [understanding] alone guarantees diagnostic excellence."

We are pleased that this book emphasizes patient education and techniques to promote adherence to therapy. Patient's with sleep-disordered breathing are at increased risk for morbidity and mortality. Once a patient has been identified as having sleep-disordered breathing and an appropriate therapy has been prescribed, a successful outcome rests, in large part, on adherence to therapy. Consequently, we believe that strategies that promote patient satisfaction and adherence to therapy are of equal importance to diagnostic and therapeutic strategies. In closing, we believe that Stradling accomplishes his goal and that the **Handbook of Sleep-Related Breathing Disorders** provides "a useful starting point to those interested in providing a [sleep and breathing] service for patients."

Michael J Decker BSN RN CRTT
Advanced Clinical Nurse

Frank J Caruso RRT
Administrative Director

Department of Adult Respiratory Care
University Hospitals of Cleveland
Cleveland, Ohio

Letters

A Reader Objects to Small-Type Abstracts

I look forward to the November issue of RESPIRATORY CARE each year because I enjoy reading the abstracts, but in the most recent printing (1994) the point size is so tiny that my poor eyes bulged and nearly hemorrhaged under the strain. I just cannot deal with such small print at this point in my life. Not only is my hair graying, but my eyes are aging. Carrots do not help. What point size did you use?

In closing, I would like to say

Whose abstracts these are I do not know
Because the point size is much too low.
So I give my magnifying glass a shake
To overcome a printer's mistake.

I wade through this morass of tiny words
And find over 175 abstracts densely packed.

Alas! Every number in abstract OF-94-200 is blurred.
What a pain in the magnifying glass!

Gregory D Hagan MAE RRT
Assistant Professor
Respiratory Care
Madisonville Community College
Madisonville, Kentucky

And the Editor Responds:

As we plotted and schemed, it did appear
That instructions to authors were perfectly clear

Accepted abstracts will be photographed...
Do not use type size less than 9 points

Our philosophy evolving ever yet—
What you send is what you get,
Though much reduced we do regret.

In '95, we expect there to be
300 abstracts that all ***can*** see
Studies and evaluations—a real mix
But with four to a page instead of six!

Pat Brougher BA RRT
Editor
RESPIRATORY CARE

Reader-Investigators Probe Differences in Aerosol Study Results

Optimal techniques for administration of metered dose inhaler (MDI) to mechanically ventilated patients are currently being evaluated. One of the parameters of significance is the timing of actuation of the MDI in relation to delivery of inspiratory airflow by the ventilator. In the September 1994 issue of RESPIRATORY CARE, Harwood, Rau, and Thomas-Goodfellow reported that 21.4% of the dose of albuterol from an MDI actuated into an AeroVent adapter in vitro deposited distal to the endotracheal tube.[1] We were intrigued by this finding because this group, using an identical model, in 1992 reported a deposition of 32.1% of the total dose.[2] In addition to the difference in the technique of processing the filters and possible variations in the sample lots cited by the authors, inspiratory flow patterns and timing of actuation of the MDI were different in the two reports.

We suspect that the timing of actuation of the MDI may be primarily responsible for the variations in deposition of albuterol observed in the two studies. In the 1992 study, the MDI was fired at the beginning of inspiration, whereas in the more recent article the MDI was fired 1 second prior to the beginning of inspiration. Crogan and Bishop,[3] cited by the authors in both articles, demonstrated that firing an MDI into a flowing gas stream at 60 L/min was more efficient (11% of dose) than firing before initiation of flow (1% of dose), using a 9.0-mm endotracheal tube (ETT). The importance of coordination of inhaler actuation with inspiratory airflow is also supported by the work of Dhand et al[4] demonstrating that most of the aerosol flume was dissipated within 100 ms (0.1 s) after actuation. Therefore, actuation of the MDI should be coordinated with generation of airflow by the ventilator.

Using a bench model with actuation of MDI into an AeroVent adapter, we[5,6] observed (and have reported in abstracts) deposition of albuterol ranging from 27 to 39.4% of the administered dose during various modes of mechanical ventilation with a dry ventilator circuit. In both studies, our deposition results agreed with the 1992 reports of Rau et al.[2] Fuller et al[7] actuating an MDI into an adapter at the ETT, at the beginning of inspiration, demonstrated in-vivo deposition of 3.89% in a ventilator circuit with humidification, which is considerably more than 1.69% reported by Harwood et al.[1]

In 1992, Rau, Harwood, and Groff used a sine-wave inspiratory flow pattern, whereas in 1994 Harwood, Rau, and Thomas-Goodfellow used an accelerating-flow waveform.[1,2] We found that a decelerating flow pattern resulted in a small but statistically significant increase in deposition over both sine- and square-wave flow patterns, but the differences we found between these flow patterns (< 10% of total deposition) would not account for the > 40% variance in deposition of albuterol between the two studies from the Rau group.[1,2]

The optimal timing for actuation of MDI in mechanically ventilated patients has not been established, but it appears from an analysis of data presented that actuation of the MDI 1 second prior to the initiation of a mechanical breath in a dry ventilator circuit reduces deposition of albuterol with an MDI and AeroVent Adapter from 32 to 21.4% and with the Medicomp ETT MDI actuator/adapter from 7.3 to 1.69%. We suggest that when an AeroVent or a Medicomp ETT actuator/adapter is used, actuation of the MDI be synchronized with the beginning of inspiration.

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a mechanically ventilated adult lung model. Respir Care 1994;39(9):886-891.
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Harwood, Rau, and Thomas-Goodfellow respond:

We appreciate the careful reading of our recent investigations concerning the delivery of aerosolized bronchodilators to intubated patients on mechanical ventilatory support and the insightful comments of Fink and Dhand. As they accurately note, we found a mean of 32.1% versus 21.4% for aerosolized drug delivery with the same reservoir device, the Monaghan AeroVent, in two different studies conducted at our institution.[1,2]

We agree that one of the possible variables causing this difference may have been a slight difference in the timing of the MDI actuations, with the timing approximately 1 second prior to mechanical inspiration giving the 21.4% delivery. A comment by Manthous and Schmidt[3] may be particularly appropriate here: "While this (Marquest) adapter was ineffective in our hands, it remains possible that some nuance of technique or timing...could be at fault. As we noted in our discussion, there were also other factors that were different in the two studies, including the filtration technique and a possible lot-size difference in the actuator nozzle on the AeroVent (according to Monaghan Medical).

We point out, however, that the inspiratory flow pattern was the same on the 900C, in both studies: the approximate sine, or accelerating pattern (the variable flow pattern). We are of the opinion that the best term for the variable flow on the 900C is an approximate sine, but the term accelerating was used based on reviewers' comments.

Although timing may not be everything when delivering an aerosol by MDI to a ventilated patient, it is intuitively important because intrinsic PEEP and residual expiratory flow may lead to a loss of aerosol if the MDI is activated too early prior to initiation of inspiration. We do not believe that the differences we have shown in the two studies completely supports the conclusion reached by Fink and Dhand because other factors vary as well. Only a controlled variation of timing alone would provide complete support for their conclusion; however, our findings certainly do not contradict their conclusion.

Although in-vitro studies provide valuable information for clinically applied aerosol delivery devices, the variation seen serves to emphasize that clinical use of these devices for dosing should be guided ultimately by the patient's response.

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Assistant Professor

Joseph L Rau PhD RRT
Professor and Chair

Lynda Thomas-Goodfellow MBA RRT
Director of Clinical Education

Department of Cardiopulmonary Sciences
Georgia State University
Atlanta, Georgia

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CORRECTION

The first line of Section 5.3 of the Clinical Practice Guideline: Body Plethysmography (Respir Care 1994;39(12):1185) was omitted during production. The section should read

5.3 Presence of devices or other conditions, such as continuous I.V. infusions with pumps or other equipment that will not fit into the plethysmograph, that should not be discontinued, or that might interfere with pressure changes (eg, chest tube, transtracheal O_2 catheter, or ruptured eardrum);

We regret the error.

Notices

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By Robert L. Chatburn, RRT

Explains how physical and mathematical models are developed and applied, how such models are incorporated into ventilator design to provide estimates of mechanics, and some of the problems that can develop because of the limitations of the models. Chatburn points out that lack of consistency among manufacturers in the way in which compliance and resistance are measured and temperature conversions are applied and how the lack of published accuracy and precision information make data interpretation difficult.

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New Products & Services

News releases about new products and services will be considered for publication in this section. There is no charge for these listings. Send descriptive release and glossy black and white photographs to Respiratory Care Journal, New Products and Services Dept, 11030 Ables Lane, Dallas TX 75229-4593.

PEDIATRIC END-TIDAL CO_2 DETECTOR. Nellcor introduces the new *PEDI-CAP* ™, the pediatric version of the company's *EASY CAP®* disposable end-tidal CO_2 detector. The *PEDI-CAP* detector changes color (from purple at inspiration to yellow at expiration) as CO_2 levels rise and fall during breathing. According to the manufacturer, it is especially suitable for use during emergency intubations to verify correct endotracheal tube placement and to warn the clinician should the tube become dislodged from the patient's airway. The *PEDI-CAP* detector is compatible with virtually all neonatal and pediatric resuscitators and can be used for up to two hours for continuous end-tidal CO_2 detection. The light-weight device, which easily fits in a pocket, is suitable for patients weighing from 1 to 15 kg; it requires no batteries, cables, connectors, or calibration. Contact Nellcor Incorporated, Dept RC, 4280 Hacienda Drive, Pleasanton CA 94588, (510) 463-4000. Please mention RESPIRATORY CARE when you call.

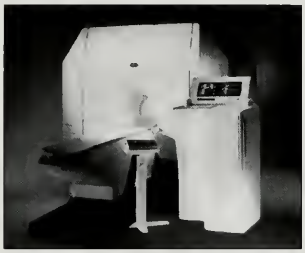
HAND-HELD CAPNOMETER. BCI International has introduced their Model 8200 Capnocheck® hand-held Capnometer. The Capnocheck provides spotcheck readings of end-tidal CO_2 and respiration rate and can verify intubation on all patients from neonate to adult. This product operates on internal rechargeable batteries and is compatible with an external commercially available printer. It can also be connected to the AC adaptor. Contact BCI International, Dept RC, W238 N1650 Rockwood Drive, Waukesha WI 53188-1199, (800) 558-2345. Don't forget to mention RESPIRATORY CARE when you call.

MEDICAL RESEARCH DATABASE. Health Information Search offers a computer search of the National Library of Medicine Databases covering research articles from over 3,500 of the leading medical journals. The search provides listings and abstracts on the latest medical research articles on any patient condition, disease, method of diagnosis, or method of treatment. Search results can also be provided from specialized databases on drug effects, cancer, AIDS, toxic materials, and other areas. An initial search providing listings and abstracts of up to 50 of the latest research articles on any given topic costs $49.75. After reviewing the listings and abstracts, copies of selected articles or listings of less-recent related articles, one can obtain at additional cost. Contact Health Information Search, Dept RC, P.O. Box 570361, Tarzana CA 91357, (800) INFO RX6. Please mention RESPIRATORY CARE when you call.

TOBY TRACHEASAURUS. Toby Tracheasaurus Therapy toys help children who require a tracheostomy tube and ventilator support to learn how to talk by utilizing the Passy-Muir speaking valve. The Toby Tracheasaurus stuffed animal and puppet dinosaur characters, which wear the speaking valve, help create a fun therapy atmosphere for children. Toby Tracheasaurus Therapy toys are made possible through corporate sponsorship by Passy-Muir, Inc. (the manufacturer of the Passy-Muir Tracheostomy Speaking Valve) and Shiley, Mallinckrodt TPI Inc (the manufacturer of Shiley Pediatric Tracheostomy Tubes). The complete line of toys includes a Toby Tracheasaurus stuffed animal, a puppet, a Toby Tote with whistle, bubbles, stickers, and toys), therapy forms and motivational progress charts. A coloring book in story format, which helps therapists and parents discuss with children what it means to have a tracheostomy, is also available. Contact Voicing, 3857 Birch, Suite 194, Newport Beach CA 92660, (714) 833-2710. Please mention RESPIRATORY CARE when you call.

ASTHMA BROCHURE. The Asthma and Allergy Foundation of America (AAFA), with an educational grant from Zeneca Pharmaceuticals, has published *Reaching for the Stars: Teens Talk to Teens about Asthma*, a new patient education brochure. The brochure contains the thoughts and quotes of nearly 100 teens who have asthma. Contact Dawn Marvin of AAFA at (202) 466-7643 for a copy. Don't forget to mention RESPIRATORY CARE when you call.

DRUG DELIVERY DEVICE. Aradigm Corporation has developed the SmartMist™ System, a microprocessor-controlled, noninvasive pulmonary drug delivery device. According to the manufacturer, the SmartMist System is an ideal platform for investigating the effects of various inhalation modes on the delivery of aerosols; it can be preprogrammed to control the delivery of medication precisely, actuating the MDI only when inhalation has reached a specific flow and volume. According to Aradigm, the SmartMist System may optimize the use of MDIs by improving the patient's inhalation technique and by monitoring compliance. The microprocessor-controlled SmartMist System records the date, time, and respiration parameters each time a patient activates the device, enabling a health care professional to access the information through a standard computer interface. Contact Melissa Prince of Aradigm at (510) 783-0100. Don't forget to mention RESPIRATORY CARE when you call.

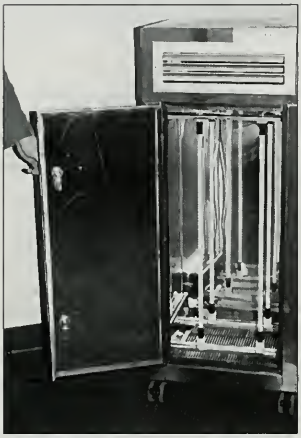


MRI MONITORING SYSTEM. The French company ODAM BRUKER introduces the new MAGLIFE system to monitor the vital signs of neonatal, pediatric, sedated, anesthetized, ventilated, or critically ill patients undergoing MRI examination. According to the manufacturer, the new MAGLIFE system enables an attendant standing next to the magnet and near the patient to survey the patient's condition and immediately react to irregularities. Installed inside a Faraday cage near the patient, the fully integrated and compact MAGLIFE system displays all the patient's vital signs and creates digital files of these parameters without interfering with the quality of the MRI images. MAGLIFE monitors ECG, S_PO_2, capnography, body temperature, and both invasive and noninvasive blood pressure. Contact French Technology Press Office, Dept RC, 401 N Michigan Avenue, Suite 1760, Chicago IL 60611, or call (312) 222-1235. Don't forget to mention RESPIRATORY CARE when you call.

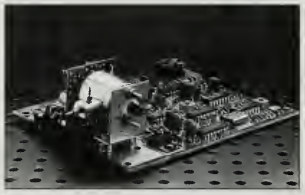
AUTOMATED LABORATORY. RALS™ Remote Automated Laboratory System, manufactured by Medical Automation Systems Incorporated, integrates proprietary software with commercially available blood analyzers to control testing performed at sites that are remote from a hospital's central clinical laboratory. Samples are analyzed at remote locations, and the results are automatically transmitted to the central laboratory for prompt review by a medical technologist. According to the manufacturer, in minutes the results are sent back to the patient site where they can be viewed by requesting physicians and technicians; the entire process takes less than five minutes. RALS is in full compliance with all CLIA regulations. For a free demonstration video, contact Medical Automation Systems Incorporated, PO Box 1906, University Station, Charlottesville VA 22903-0506, (804) 971-7953. Please mention RESPIRATORY CARE when you call.

CLINICAL ANALYZER. A clinical chemistry analyzer with random access capability, LISA can process up to 24 parameters (from 48 parameters) at a rate of 150 tests/hr. Designed by the French company HYCEL Groupe LISABIO, LISA can perform a wide range of applications, including routine chem-istries, specific proteins, immunoassay, and chromogenic substrates. Analytical operations like rerun, stat, and sample dilution pretreatment are fully automatic; 96 sample positions for primary tubes and cups are available. According to the manufacturer, the user-friendly software, which features an on-line QC combined with an advanced techno-

logical analyzer, promotes efficient organization and meets modern laboratory requirements. Contact French Technology Press Office, Dept RC, 401 N Michigan Avenue, Suite 1760, Chicago IL 60611, or call (312) 222-1235. Don't forget to mention RESPIRATORY CARE when you call.



ULTRAVIOLET AIR SCRUBBER. Modern Medical's new, portable, ultraviolet air sanitizer is designed to replace the usual roll- around HEPA-filtered air cleaner used by hospitals to catch TB droplet nuclei. According to the manufacturer, the units are safe and effective, and the cumbersome bag-in, bag-out procedure is eliminated because there are no filters to change. The irradiance is designed for 99+% kill at 10,000 uw sec/cm^2 dosage. The throughput is 400 CFM, and the ultraviolet lights are warranted for continuous use of 10,000 hours. Contact Modern Medical Systems Company, Dept RC, 1655 Jericho Turnpike, New Hyde Park NY 11040, (516) 775-5550. Don't forget to mention RESPIRATORY CARE when you call.



CO_2 SENSOR. Servomex Company announces its Model 1505 Infrared Bench for OEM applications that require a small, fast CO_2 sensor. The Model 1505 features a solid state source and detector and has no moving parts. According to Servomex, it is free from ambient CO_2 effects, eliminates the need for a scrubbing system, and offers user-selected linear or nonlinear output signals. The 1505 operates from low power, has fast warmup, and requires a minimum of space. Contact Servomex Company Inc, Dept RC, 90 Kerry Place, Norwood MA 02062, (800) 862-0200. Please mention RESPIRATORY CARE when you call.

COUPLINGS FOR PLASTIC TUBING. Delrin® Acetal couplings for 1/16" to 3/8" tubing, polypropylene couplings for 1/4" to 3/4" tubing, and polysulfone couplings for 3/8" to 3/4" tubing are available from Colder Products Company in National Sanitation Foundation (NSF) Standard C-2 listed versions for food and beverage equipment. According to the manufacturer, the NSF listed couplings have unique push-button latch design for easy one-hand disconnects. Push the coupling halves together to reconnect; shutoff valves automatically stop the fluid flow when the coupling halves are separated. Built-in fitting configurations include panel mount, in-line, pipe thread, and elbows for 1/16" to 3/4" tubing connections. Contact Steve DeWitt, Colder Products Company, Dept RC, 1001 Westgate Drive, St Paul MN 55114, (800) 444-2474. Don't forget to mention RESPIRATORY CARE when you call.

Monitorización del flujo espiratorio máximo:
Guía para el paciente asmático
MONITORIZACIÓN DEL FLUJO ESPIRATORIO MÁXIMO CON PERSONAL BEST
CÓMO CONTROLAR SU ASMA

ASTHMA INFORMATION IN SPANISH. Health-Scan Products Inc has developed peak flow monitoring patient education pamphlets in Spanish for use with ASSESS® and Personal Best® peak flow meters. According to HealthScan, the booklets explain the importance of peak flow monitoring at home for better asthma management; they also describe the three-zone system that helps patients understand their peak flow measurements. Call the HealthScan Products Customer Service Department at (800) 962-1266. Don't forget to mention RESPIRATORY CARE when you call.

1995 Call for Abstracts

RESPIRATORY CARE • OPEN FORUM

The American Association for Respiratory Care and its science journal, RESPIRATORY CARE, invite submission of brief abstracts related to any aspect of cardiorespiratory care. The abstracts will be reviewed, and selected authors will be invited to present papers at the OPEN FORUM during the AARC Annual Meeting in Orlando, Florida, December 2-5, 1995. Accepted abstracts will be published in the November 1995 issue of RESPIRATORY CARE. Membership in the AARC is not necessary for participation.

SPECIFICATIONS—READ CAREFULLY!

An abstract may report (1) **an original study,** (2) **the evaluation of a method or device,** or (3) **a case or case series.** Topics may be aspects of adult acute care, continuing care/rehabilitation, perinatology/pediatrics, cardiopulmonary technology, health-care delivery. The abstract may have been presented previously at a local or regional—but not national—meeting and should not have been published previously in a national journal. The abstract will be the only evidence by which the reviewers can decide whether the author should be invited to present a paper at the OPEN FORUM. Therefore, *the abstract must provide all important data, findings, and conclusions.* Give specific information. Do not write such general statements as "Results will be presented" or "Significance will be discussed."

Essential Content Elements

An original study abstract *must* include (1) Introduction: statement of research problem, question, or hypothesis; (2) Method: description of research design and conduct in sufficient detail to permit judgment of validity; (3) Results: statement of research findings with quantitative data and statistical analysis; (4) Conclusions: interpretation of the meaning of the results. **A method/device evaluation** abstract *must* include (1) Introduction: identification of the method or device and its intended function; (2) Method: description of the evaluation in sufficient detail to permit judgment of its objectivity and validity; (3) Results: findings of the evaluation; (4) Experience: summary of the author's practical experience or a lack of experience; (5) Conclusions: interpretation of the evaluation and experience. Cost comparisons should be included where possible and appropriate. **A case report** abstract *must* report a case that is uncommon or of exceptional teaching/learning value and must include (1) patient data and case summary and (2) significance of case. Content should reflect results of literature review. The author(s) should have been actively involved in the case and a case-managing physician must be a co-author or must approve the report.

Abstract Format and Typing Instructions

Accepted abstracts will be photographed. First line of abstract should be the title in all capital letters. Title should explain content. Follow title with names of all authors (including credentials), institutions(s), and location. Underline presenter's name. Type or electronically print the abstract *single spaced in the space provided on the abstract blank.* Insert only one letter space between sentences. Text submission on diskette is encouraged but must be accompanied by a hard copy. Identifiers will be masked (blinded) for review. Make the abstract all one paragraph. Data may be submitted in table form *and simple figures may be included provided they fit within the space allotted.* No figures, illustrations, or tables are to be attached to the abstract form. Provide all author information requested at the bottom of abstract form. A clear photocopy of the abstract may be used. Standard abbreviations may be employed without explanation. A new or infrequently used abbreviation should be preceded by the spelled-out term the first time it is used. Any recurring phrase or expression my be abbreviated if it is first explained. Check the abstract for (1) errors in spelling, grammar, facts, and figures; (2) clarity of language; and (3) conformance to these specifications. An abstract not prepared as requested may not be reviewed. Questions about abstract preparation may be telephoned to the editorial staff of RESPIRATORY CARE at (214) 243-2272.

Deadline Allowing Revision

Authors may choose to submit abstracts early. Abstracts received by March 15 will be reviewed and the authors notified by April 22. Rejected abstracts will be accompanied by a written critique that should in many cases enable authors to revise their abstracts and resubmit them by the final deadline (May 27).

Final Deadline

The mandatory Final Deadline is May 27 (postmark). Authors will be notified of acceptance or rejection *by letter only*—to be mailed by August 15.

Mailing Instructions

Mail (Do not fax!) 2 clear copies of the completed abstract form and a stamped, self-addressed postcard (for notice of receipt) to:

RESPIRATORY CARE OPEN FORUM
11030 Ables Lane
Dallas, TX 75229-4593

1995 Respiratory Care Open Forum
Abstract Form

18.8 cm or 7.4"

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1. Title must be in all upper case (capital) letters, authors' full names and text in upper and lower case.
2. Follow title with all authors' names including credentials (underline presenter's name), institution, and location.
3. Do not justify (ie, do leave 'ragged' right margin).
4. **Do not use type size less than 10 points.** (See reduction samples below.)
5. All text, tables, and figures must fit into the rectangle shown.
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Mail original & 1 photocopy (along with postage-paid postcard) to

Respiratory Care Open Forum
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Dallas TX 75229-4593

Early deadline is March 15, 1995 (abstract received)

Final deadline is May 27, 1995 (abstract postmarked)

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Presenter's Mailing Address

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Corresponding Author's Name & Credentials

Corresponding Author's Mailing Address

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IISPs...

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Nicotine Dependency Evaluation and Treatment
Helps you understand the physiologic effects of nicotine and the tests and questions used to evaluate dependency. Provides an understanding of nicotine, its effects on brain chemistry, its measurement in bodily fluids, and the value of self-tests to determine addiction level. Also teaches about nicotine replacement and how to enhance it with behavioral counseling.
Item SC1 $10 each
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Bedside Counseling of the Hospitalized Smoker
Prepares you for the role of a smoking cessation counselor to hospital inpatients by teaching assessment and bedside counseling. Help patients cope with nicotine withdrawal, increase motivation for permanent cessation, and understand the factors contributing to relapse.
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Neonatal

Recognition and Stabilization of the Premature Infant in Respiratory Distress
This IISP helps you identify primary risk factors associated with premature birth. Discusses and explains the importance of providing a neutral-thermal environment for the premature infant and the necessity of continuous noninvasive oxygen monitoring of the premature infant on supplemental oxygen. You will also learn to recognize aberrant blood gases in the neonate and oxygen therapy initiation with an oxygen hood.
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Clinical Science

Transpulmonary Pressure Changes in Breathing
Discusses the pulmonary pressures and how they vary during normal breathing and in special situations. Instructs on barometric, alveolar, intrapleural, transpulmonary, chest wall, and transthoracic pulmonary pressures.
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Lung Mechanics
Assists you in understanding the pulmonary characteristics of compliance and resistance, how these characteristics can change, and their influence on mechanical ventilator performance.
Item CS6 $10 each
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Practical Application of Gas Laws
A common-sense approach to the gas laws and how to apply them to respiratory care. Defines the laws of Boyle, Charles, Gay-Lussac, Dalton, Graham, and Henry.
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Tonicity of Solutions and the Respiratory Tract
Gives you an understanding of how to predict the effects of therapeutic solutions on the respiratory tract and how to utilize them in the treatment of various respiratory tract pathologies.
Item CS8 $7 each
($12 nonmembers)

Carbon Monoxide Inhalation: Introduction to Physiologic Effects and Respiratory Management
Explains the effects of carbon monoxide inhalation on oxygen transport mechanisms in the body and the use of CO in physiologic tests of pulmonary function. Also covers recognition signs and symptoms, treatment of CO poisoning, and the equipment used to administer therapy.
Item CS9 $10 each
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Electrical Safety in Respiratory Therapy I: Basic Electrical Circuitry
Enables you to relate the basic principles of electrical theory to commonly used equipment and procedures in the clinical environment and provides you with an understanding of electrical safety in respiratory care.
Item CS12 $7 each
($12 nonmembers)

Electrical Safety in Respiratory Therapy II: Identification of Electrical Hazards
Helps you identify and, where possible, minimize or eliminate common electrical hazards. Teaches differentiation between electrical hazards and which patients and hospital personnel are exposed.
Item CS13 $7 each
($12 nonmembers)

Bronchodilators I: Sympathomimetic Amines
Understand the results of stimulating the autonomic nervous system and the use of sympathomimetic drugs to accomplish bronchodilation. Exposes you to basic aspects of adrenergic bronchodilators and the patient situations for which they are indicated.
Item CS14 $10 each
($15 nonmembers)

Bronchodilators II: Anti-Cholinergics and Xanthines
Identifies the three categories of drugs that promote bronchodilation and the mechanism of action for each. This package also provides examples of drugs in each category. Clinical situations are presented with methods of bronchodilaton and rationale for method selected.
Item CS15 $10 each
($15 nonmembers)

Calculation and Preparation of Respiratory Medications
Teaches you how to calculate and prepare percentage solutions, ration solutions, solutions prepared from solutes less than 100 percent in strength, and how to prepare dosages from powdered drugs.
Item CS16 $10 each
($15 nonmembers)

Microbiology for Respiratory Therapy: A Review of Microbial Growth and Cross-Contamination
Provides an overview of microbiology in respiratory care, including groups and characteristics of microbes, requirements for microbial growth, cross-contamination, and prevention of transmission.
Item CS17 $9 each
($14 nonmembers)

Classification of Mechanical Ventilators I
Outlines the basic concepts of ventilator classification and a mathematical model of the respiratory system that provides the basis for classifying ventilator control systems. Also teaches the specific criteria for determining whether a ventilator primarily controls pressure, volume, or flow.
Item CS18 $10 each
($15 nonmembers)

Classification of Mechanical Ventilators II
You will learn detailed information about the control of ventilation in terms of switching from inspiration to expiration. You will also be introduced to the common drive mechanisms used in various mechanical devices.
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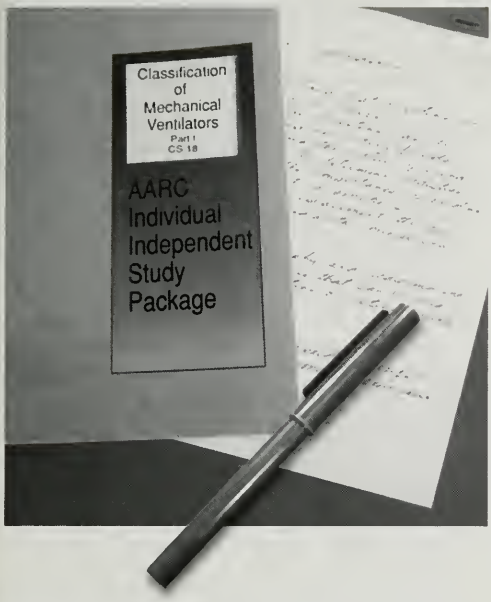

Classification of Mechanical Ventilators III
Explores the output waveforms that ventilators produce and their clinical implications. Instructs in the various modes of ventilation in terms of the specific combinations of control characteristics along with ventilator performance testing and the practical application of ventilator classification.
Item CS20 $10 each ($15 nonmembers)

Ventilation/Perfusion Relationships In Health and Disease
Covers the different degrees of hypoxia commonly encountered in patients with pulmonary disease. Focuses on ventilation/perfusion abnormalities, which account for much of the severe hypoxia in COPD, with alveolar hypoventilation also a contributing factor.
Item CS21 $10 each ($15 nonmembers)

Patient Evaluation

Pulmonary Function Assessment I: Basic Screening Studies
Understand simple spirometry results, the definition of obstructive and restrictive pulmonary disorders, and the basic pathology involved in each. Covers the four reasons for simple spirometry tests, the common parameters of lung function, and the results that are indicative of obstructive and restrictive pulmonary disorders.
Item PE3 $8 each ($13 nonmembers)

Pulmonary Function Assessment II: Bedside Studies
Familiarizes you with the use and interpretation of bedside pulmonary function tests. Learn how pulmonary function test results are used to assess ventilatory ability and which tests are commonly used. Also learn the measuring instrument required for each test, how it is performed, and what is significant about the results.
Item PE4 $7 each ($12 nonmembers)

Pulmonary Function Assessment III: Lung Volume Determination and Closing Volume Studies
Assists in the recall of the eight subdivisions of total lung volume and their individual characteristics in health and disease. Discusses the measurement of lung volume by nitrogen washout, helium dilution, and closing volume techniques.
Item PE5 $7 each ($12 nonmembers)

Body Plethysmography
Explains the theory of body plethysmography and its use in the measurement of FRC and airway resistance. Defines and describes Boyle's Law, thoracic volume, airway resistance and its normal values, and the measurement of airway resistance.
Item PE6 $9 each ($14 nonmembers)

Sources of Error in the Determination of Blood Gas Values and pH
Familiarizes you with the errors that may occur in the analysis of blood gases and pH. These are often the most important laboratory data used in the diagnosis and treatment of pulmonary disease, and errors in these values can result in deleterious effects on patient care.
Item PE7 $10 each ($15 nonmembers)

Temperature Adjustment of Blood Gases and pH
Teaches you the effects of abnormal body temperature on blood gas and pH values. Blood gas values and pH are determined at 37 degrees Celsius, and this package teaches you how to adjust these values.
Item PE8 $10 each ($15 nonmembers)

Updated! Plotting Static and Dynamic Compliance Curves During Mechanical Ventilation
Learn how to compute and record static compliance curves and dynamic characteristics. Also learn the procedure of obtaining pressure-volume measurements and interpret the compliance characteristics measurements.
Item PE9 $10 each ($15 nonmembers)

Arterial Blood Gas Interpretation
Teaches you ABG interpretation in order that the prescribed therapy can be administered in a knowledgeable manner. Describes a systematic method that allows you to correctly classify the acid/base dysfunction and to relate the diagnosis concisely and coherently.
Item PE10 $10 each ($15 nonmembers)

Clinical Practice

Chest Tubes and Pleural Drainage
Helps you understand the purpose of pleural drainage, how it might affect the patient's respiratory status, and what precautions you must take when working with patients who are receiving pleural drainage.
Item CP3 $10 each ($15 nonmembers)

Tracheal Intubation I: Upper Airway Anatomy and Goals of Intubation
After completing this IISP, you will understand the rationale for tracheal intubation and be able to identify the important landmarks of upper airway anatomy.
Item CP4 $7 each ($12 nonmembers)

Tracheal Intubation II: Routes of Intubation
Describes the four routes of tracheal intubation and some advantages and hazards of each. Also presents the process for selecting the most suitable route in a given situation.
Item CP5 $7 each ($12 nonmembers)

Tracheal Intubation III: Equipment Procedures for Intubation
Covers the selection of the proper equipment necessary to perform endotracheal intubation and to ensure that they are in working order.
Item CP6 $8 each ($13 nonmembers)

Respiratory Management of Neuromuscular Crisis
Teaches respiratory management of patients with ventilatory failure caused by a neuromuscular disorder. Provides a basic understanding of how neuromuscular conditions lead to ventilatory insufficiency and the considerations to be taken when working with these patients.
Item CP7 $7 each ($12 nonmembers)

Respiratory Management of Flail Chest
This study package helps you increase your understanding of the pathophysiology of flail chest and the respiratory management of patients who have sustained chest wall trauma that results in a flail chest.
Item CP8 $10 each ($15 nonmembers)

Respiratory Management of Head Trauma
Teaches identification of the five physical signs indicative of head trauma and explains the development of respiratory failure secondary to trauma. Also discusses airway management, drug therapy, ventilator parameters, acid-base status, and measures to be taken to maintain the appropriate pH, P_{aCO_2} and P_{aO_2}.
Item CP9 $10 each ($15 nonmembers)

Calendar of Events

Not-for-profit organizations are offered a free advertisement of up to eight lines to appear, on a space-available basis, in Calendar of Events in RESPIRATORY CARE. Ads for other meetings are priced at $5.50 per line and require an insertion order. Deadline is the 20th of the month two months preceding the month in which you wish the ad to run. Submit copy and insertion orders to Calendar of Events, RESPIRATORY CARE, 11030 Ables Lane, Dallas TX 75229-4593.

AARC & AFFILIATES

February 16–17 in Atlanta, Georgia. The Perinatal/Pediatric Committee of the GSRC announces a perinatal/pediatric review course at Piedmont Hospital. Contact David Ellwanger, Respiratory Care Services, Piedmont Hospital, 1968 Peachtree Rd, Atlanta GA 30309, (404) 605-3657.

February 17–19 in Washington, District of Columbia. The Maryland/DC and Virginia Societies for Respiratory Care present the Mid-Atlantic Regional Conference for Respiratory Care at the Omni Shoreham Hotel. Choose from 39 lectures and workshops. Planned events include a student luncheon, a managers' breakfast, a political reception, poster presentations, and a dance. Participants can earn up to 16 hours of CRCE credit. Contact Susan Telmanik or Ben Schowe at (804) 947-4538.

February 23–24 in Kansas City, Missouri. The MRCS, the KRCS, and the Respiratory Care Management Association present the 5th Annual Midwest Respiratory Care Symposium. Featured topics include a cystic fibrosis update, the effect of noise in the NICU, hemodynamics, the future of pulmonary rehabilitation, and implications of ventilator support for terminally ill patients. Contact Mary Cullen CRTT, at (816) 276-8711.

March 1–3 in Champion, Pennsylvania. The PSRC, in conjunction with the University of Pittsburgh at Johnstown, announces the 15th Annual South Central Respiratory Care Symposium, "Conference at the Slopes," at Seven Springs Ski Resort. Lung transplant updates, rehab and home care concerns, humor in medicine, legal issues in health care, and sleep disorders are among the topics to be covered. Contact Sandy Smith at (814) 269-2949 or fax (814) 269-2966.

March 8–10 in Southshore Lake Tahoe, California. Chapter 9 of the CSRC and the American Lung Association of Alameda County host the 17th Annual Tahoe Conference, "Enhancing Our Future... From Hospital to Home," at the Embassy Suites. Contact Kathy Gallego at (510) 947-5370 or George Rice at (510) 947-5292.

March 12–15 in Denver, Colorado. The AARC and the National Jewish Center for Immunology and Respiratory Medicine announce the 5th International Conference on Pulmonary Rehabilitation and Home Ventilation at the Hyatt Regency Hotel. Pre- and post-conference postgraduate workshop topics include pulmonary rehabilitation, home ventilator care, respiratory sleep disorders, nicotine dependency treatment, and transtracheal oxygen. The program is endorsed by the American College of Chest Physicians; program chairman is Barry Make, MD. Contact the National Jewish Office of Professional Education at (303) 398-1000.

March 30–31 in Los Angeles, California. The CSRC Chapter 4, Queen of Angels–Hollywood Presbyterian Medical Center, and the Children's Hospital of Los Angeles present the 10th Annual Symposium, "Clinical Advances in Ventilator Technology." According to CSRC Chapter 4, this symposium meets continuing education requirements for all California RCPs. Contact Carrie Comorre, QAHP Medical Center, 1300 N Vermont Ave, Suite 810, Los Angeles CA 90027, (213) 664-6180.

April 10–12 in Philadelphia, Pennsylvania. The Southeast District of the PSRC presents its 30th Annual Conference and Exhibition, "Meeting the Challenge," at the Adam's Mark Hotel. Topics covered in the 3-day seminar include issues regarding protocols, respiratory care in alternative work sites, specialized diagnostics, and new ventilator strategies. Contact Kathy Fallon at (215) 842-6590 or Denise McCardle at (215) 961-2131.

April 17–19 in Bellevue, Washington. The Respiratory Care Society of Washington announces the 22nd Annual Pacific Northwest Regional Respiratory Care Conference at the Bellevue Red Lion Inn. Management, pediatrics, and education are featured subjects. The latest in health care equipment will be on display for two days. For a brochure, contact Bob Bonner, Chair, Health, Education, and PE Division, Highline Community College, PO Box 98000, Des Moines WA 98198, (206) 878-3710, ext 469.

April 25–28 in Cincinnati, Ohio. Region II for Respiratory Care (the Ohio, Kentucky, and Indiana societies) hosts its 22nd Annual Meeting, "Charting New Waters," at the Albert B Sabin Convention Center and Hyatt Regency Hotel. Contact Jeff Jones RRT, 1995 Chairman of Region II, at (513) 438-0388.

May 10–12 in South Padre Island, Texas. The Rio Grande Valley District of the TSRC presents its annual seminar at the Sheraton Beach Resort. Featured topics include neonatal and adult critical care and methods to enhance development of critical pathways. CRCE credit has been requested. The registration fee, which includes a banquet ticket, is $50; the cost of the scheduled fishing trip is extra. Contact TSRC, PO Box 2048, Harlingen TX 78551. The deadline for discount room confirmation at the Sheraton is April 9; call the resort at (800) 672-4747, and mention the seminar to receive a discount rate.

OTHER MEETINGS

February 23–26 in Fort Worth, Texas. The Association for Gerontology in Higher Education (AGHE) presents its annual meeting, entitled "Leadership in Gerontology: Continuously Improving the Quality of Education," at the Worthington Hotel. Contact AGHE, c/o School of Medicine, Oregon Health Sciences University, 3181 SW Sam Jackson Park Rd, Portland OR 97201.

March 2–5 in Orlando, Florida. The American College of Chest Physicians (ACCP), in cooperation with the European Respiratory Society, presents the 5th International Conference on Environmental and Occupational Lung Disease at the Hilton at Walt Disney World. Contact the ACCP, 3300 Dundee Rd, Northbrook IL 60062-2348.

March 21–22 in Durham, North Carolina. The Respiratory Care Departments of Duke University Medical Center, Durham Regional Hospital, Durham Technical Community College, and University of North Carolina Hospitals announce the 9th Annual Cardiopulmonary Technology Update at the Omni Durham Hotel & Convention Center. Dr Forrest Bird is the keynote speaker of the seminar, which features an exhibit hall displaying the latest advances in medical scientific equipment and services. Registration for the 2-day seminar is $70. Contact Thilo Hanisch RRT, or Kathy Waters RRT, at (919) 966-1336 or Chuck Alford at (919) 470-5366 or fax (919) 966-7647.

March 22–23 in Baltimore, Maryland. The Johns Hopkins Hospital Department of Respiratory Care presents a 2-day respiratory and critical care medicine seminar in the Turner Auditorium of The Johns Hopkins University School of Medicine. Topics include: ventilatory management of head and chest trauma, rehabilitation of ventilator-dependent patients, noninvasive mechanical ventilation, legal issues for the health care professional, invasive vs noninvasive monitoring in mechanical ventilation, hyperbaric oxygen therapy, high-frequency oscillation, treatment of chronic lung disease in children, surfactant therapy, pediatric ECMO, ribavirin uses and updates, synchronous ventilation in infants, and a cystic fibrosis update. Approval for 14 Category I hours of CRCE credit is pending. Registration for the 2-day seminar is $100 for AARC members and $120 for nonmembers. Contact Tony Bilenki at (410) 955-9276.

March 23–25 in Cleveland, Ohio. The Cleveland Clinic Foundation presents a continuing education program entitled "Pulmonary & Critical Care Medicine" at The Cleveland Clinic's Bunts Auditorium. The course has been approved for Category I accreditation. Call The Cleveland Clinic Foundation at (800) 762-8173.

April 5–7, 1995 in San Francisco, California. The California Society for Pulmonary Rehabilitation (CSPR) announces its annual conference at the Sir Francis Drake Hotel. A preconference workshop is offered April 5 from 1:30 p.m. to 5 p.m. for $30; participants may choose one of two workshop topics: transtracheal oxygen or new pulmonary rehabilitation. The April 6-7 conference fee, which includes two lunches, is $175 for CSPR members and $250 for nonmembers; topics include therapeutic strategies in asthma, advanced applications for transtracheal oxygen, reimbursement, and cardiac complications with pulmonary patients. Contact Gerilynn Connors BS RRT or Kathleen Morris MSN RRT at (707) 963-6588.

May 2–3 in Little Rock, Arkansas. Arkansas Children's Hospital presents the Diamond Conference on the hospital campus. Focus sessions on redefining physiotherapy and redirecting ventilatory strategies feature presentations and panel discussions. Roundtable lunch discussions are also planned. Abstracts will be accepted for poster presentation through March 1; selected abstracts will be chosen for slide presentation. Contact Mike Anders RRT at (501) 320-3535 or fax (501) 320-3411.

May 20–24 in Seattle, Washington. The American Thoracic Society hosts its annual International Conference, featuring a variety of symposia and workshops on the prevention and control of lung disease. Contact 1995 International Conference, American Thoracic Society, 1740 Broadway, New York NY 10019-4374, (212) 315-8700.

October 29–November 2 in New York, New York. The 61st Annual International Scientific Assembly sponsored by the American College of Chest Physicians (ACCP) at the New York Hilton and Towers is entitled "Chest 1995: Prevention and Diagnosis of Chest Disease." Contact the ACCP, 3300 Dundee Rd, Northbrook IL 60062-2348.

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A ❑ Respiratory Therapy
B ❑ Cardiopulmonary
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2 ❑ Pennatal Pediatrics
3. ❑ Critical Care
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6 ❑ Home Care/Rehab
7. ❑ Education
8 ❑ Management
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B ❑ Chief Therapist
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E ❑ Staff Therapist
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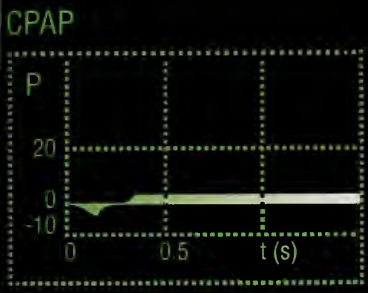

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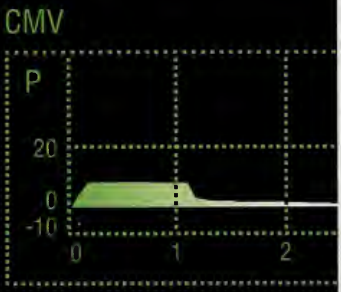

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